

Fig. 8

## Saturated fats and the risk of heart disease

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### AOCS Mission Statement

To be a global forum to promote the exchange of ideas, information, and experience, to enhance personal excellence, and to provide high standards of quality among those with a professional interest in the science and technology of fats, oils, surfactants, and related materials.

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# Calendar

**Bold type:** new listingFor details on these and other upcoming meetings, visit [www.aocs.org/meetings](http://www.aocs.org/meetings).

## July

July 1–3, 2009. 6th GERLI (Groupe d'Etude et de Recherche en Lipidomique) Meeting, Rennes, France. Information: [www.gerli.com/calendrier2.htm](http://www.gerli.com/calendrier2.htm).

July 1–3, 2009. 4th International Dietary Fibre Conference, Schönbrunn Palace, Vienna, Austria. Information: [www.icc.or.at/events/df09](http://www.icc.or.at/events/df09).

July 12–15, 2009. 86th Canadian Seed Trade Association Annual Meeting, Westin Whistler Resort & Spa, Whistler, British Columbia. Information: [www.cdnseed.org](http://www.cdnseed.org).

July 12–15, 2009. 96th Annual Meeting of the International Association for Food Protection, Grapevine, Texas, USA. Information: [www.foodprotection.org/meetingsEducation/2009ammain.asp](http://www.foodprotection.org/meetingsEducation/2009ammain.asp).

July 19–22, 2009. Sixth Annual World Congress on Industrial Biotechnology & Bioprocessing, Palais des congrès de Montréal, Québec, Canada. Information: [www.bio.org/worldcongress](http://www.bio.org/worldcongress).

July 19–24, 2009. Molecular and Cellular Biology of Lipids, Gordon Research Conferences, Waterville Valley Resort, Waterville Valley, New Hampshire, USA. Information: [www.grc.org](http://www.grc.org).

**July 22–23, 2009. SFC 2009: 3rd International Conference on Packed-Column SFC [Supercritical Fluid**

**Chromatography], Radisson Plaza-Warwick Hotel, Philadelphia, Pennsylvania, USA. Information: [www.greenchemistrygroup.org](http://www.greenchemistrygroup.org),**

## August

August 2–4, 2009. 5th Annual Practical Short Course on Water Issues & Technologies, College Station, Texas, USA. Information: <http://foodprotein.tamu.edu/separations/scwater.php>.

August 10–15, 2009. World Soybean Research Conference VIII/Soybean Industry Forum, Yayuncun (Asian Games Village), Beijing, China. Information: [www.wsrc2009.cn/en/index.asp](http://www.wsrc2009.cn/en/index.asp).

## September

September 1–5, 2009. 50th International Conference on the Bioscience of Lipids, Regensburg, Germany. Information: e-mail: [info.icbl@klinik.uni-regensburg.de](mailto:info.icbl@klinik.uni-regensburg.de); [www.icbl2009.de](http://www.icbl2009.de).

September 9–15, 2009. FEBS Advanced Course, Lipid Signaling and Disease, Hotel Mara, Ortona, Italy. Information: [www.negrissud.it/febs2009](http://www.negrissud.it/febs2009).

**September 13–16, 2009. AACC International Annual Meeting 2009, Baltimore Convention Center, Baltimore, Maryland, USA. Information: <http://meeting.aaccnet.org>.**

September 15–17, 2009. HBA Expo, Jacob Javits Center, New York City, USA. Information: [www.hbaexpo.com](http://www.hbaexpo.com).

September 16–18, 2009. oils+fats, International Trade Fair for the Production and Processing of Oils and Fats Made from Renewable Resources, New Munich Trade Fair Centre, Munich-Riem Germany. Information: [www.oils-and-fats.com](http://www.oils-and-fats.com).

**September 21, 2009. Short Course on Refining, Handling, and Applications of Palm Oil, Hilton Cartagena,**

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## AOCS Meeting Watch

September 21, 2009. Short Course on Refining, Handling, and Applications of Palm Oil, Hilton Cartagena, Cartagena, Colombia. Information: [www.aocs.org/Palma](http://www.aocs.org/Palma).

September 26–27, 2009. 9th AOCS Practical Edible Oil Refining Short Course, Process Optimization, Equipment and Technology Selection, and On-Line Process Control, Sydney, Australia. Information: [www.aocs.org/meetings](http://www.aocs.org/meetings).

September 26–27, 2009. Lipid Oxidation and Antioxidants Short Course, Sydney, Australia. Information: [www.aocs.org/meetings](http://www.aocs.org/meetings).

October 3–4, 2009. Crystallization of Lipids Conference, Toronto, Ontario, Canada. Information: [www.aocs.org/meetings](http://www.aocs.org/meetings).



[aocs.org/meetings](http://aocs.org/meetings).

November 15–17, 2009. 2nd International Congress on Biodiesel: The Science and the Technologies, The Westin Hotel, Munich, Germany. Information: [www.aocs.org/meetings/biodiesel09](http://www.aocs.org/meetings/biodiesel09).

May 16–19, 2010. 101st AOCS Annual Meeting and Expo, Phoenix Convention Center, Phoenix, Arizona, USA. Information: [http://Annual\\_Mtg.aocs.org](http://Annual_Mtg.aocs.org); phone: +1-217-359-2344; fax: +1-217-351-8091; e-mail: [meetings@aocs.org](mailto:meetings@aocs.org).

October 4–6, 2009. 23rd Meeting of the Canadian Section of the AOCS: Lipid Functionality in Processed Foods, Toronto, Ontario, Canada. Information: [www.aocs.org/meetings](http://www.aocs.org/meetings).

For in-depth details on these and other upcoming meetings, visit [www.aocs.org/meetings](http://www.aocs.org/meetings).

**Cartagena, Colombia. Information:** [www.aocs.org/Palma](http://www.aocs.org/Palma).

**September 21–23, 2009. Atlantic Bioenergy Conference 2009, Delta Beauséjour, Moncton, New Brunswick, Canada. Information:** [www.atlanticbioenergy.ca](http://www.atlanticbioenergy.ca).

**September 22–25, 2009. XVI Conferencia Internacional sobre Palma de Aceite y Exopalma, Centro de Convenciones, Cartagena de Indias, Colombia. Information:** [www.fede-palma.org/conferencia2009](http://www.fede-palma.org/conferencia2009).

September 23–25, 2009. International Forum on Emerging Technologies in Food Processing—Providing a Secure and Safe Food Supply, Campbell Alumni Center, University of Illinois, Urbana, USA. Information: William Artz, phone: +1-217-333-9337; fax: +1-217-333-9329; e-mail: [wartz@illinois.edu](mailto:wartz@illinois.edu); [http://fshn.illinois.edu/food\\_processing\\_forum](http://fshn.illinois.edu/food_processing_forum).

September 26–27, 2009. 6th International Symposium on Deep-Frying, Sydney, Australia. Information: [www.eurofedlipid.org](http://www.eurofedlipid.org).

September 26–27, 2009. 9th AOCS Practical Edible Oil Refining Short Course, Process Optimization, Equipment and Technology Selection, and On-Line Process Control, Sydney, Australia. Information: [www.aocs.org/meetings](http://www.aocs.org/meetings).

September 26–27, 2009. Lipid Oxidation and Antioxidants Short Course, Sydney, Australia. Information: [www.aocs.org/meetings](http://www.aocs.org/meetings).

September 27–30, 2009. World Congress on Oils and Fats and 28th ISF Congress, Sydney Convention and Exhibition Centre, Darling Harbor, Sydney, Australia. Information: [www.isfsydney2009.com](http://www.isfsydney2009.com).

## October

October 2–3, 2009. Crystallization of Lipids Conference, Toronto, Ontario, Canada. Information: [www.aocs.org/meetings](http://www.aocs.org/meetings).

October 4–6, 2009. 23rd Meeting of the Canadian Section of the AOCS: Lipid Functionality in Processed Foods, Toronto, Ontario, Canada. Information: [www.aocs.org/meetings](http://www.aocs.org/meetings).

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AOCS

2710 South Boulder Drive  
P.O. Box 17190  
Urbana, IL 61803-7190 USA  
Phone: +1-217-359-2344  
Fax: +1-217-351-8091  
E-mail: [publications@aocs.org](mailto:publications@aocs.org)

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# Saturated fats and the risk of heart disease

Gerald P. McNeill

For decades, the diet-heart hypothesis has dominated our understanding of the effects of food composition on our risk of cardiovascular disease (CVD). The hypothesis states that people with elevated levels of serum or LDL cholesterol (low-density lipoprotein, or “bad” cholesterol) have a higher risk of CVD. Therefore, consumption of foods that cause an increase in serum or LDL cholesterol, such as saturated fat, should result in an increased risk of CVD.

However, a large body of data generated over the last two decades shows that the effect of saturated fat on CVD is not that simple, and that saturated fats may not be as bad as we once thought. Over 20 years ago, a component of serum cholesterol called HDL (high-density lipoprotein, or “good” cholesterol) was discovered that has the opposite effect on risk of CVD to LDL cholesterol. Different dietary fatty acids have independent effects on LDL and HDL; therefore, it is critical to include both these components in any discussion about saturated fat. The most nearly accurate indicator of risk of CVD is the LDL/HDL ratio or the closely related total/HDL ratio that is commonly used by the medical profession.

Consideration of the effect of individual fatty acids on risk of CVD began in earnest in the 1980s when researchers Scott M. Grundy, Margo A. Denke, and others discovered that consumption of stearic acid (an 18-carbon saturated fatty acid found in animal fats and cocoa butter) did not appear to raise serum cholesterol or LDL cholesterol levels in human subjects. This observation contrasted with other commonly occurring dietary saturated fats including palmitic, myristic, and lauric acids that already were known to increase serum cholesterol. The diet-heart hypothesis predicted that if stearic acid did not raise serum or LDL cholesterol, then it should not increase the risk of CVD either.

Grundy and colleagues also found that oleic acid (18:1) but not stearic acid (18:0) content increased in blood serum after consumption of stearic acid. This led them to speculate that stearic acid might be rapidly metabolized to oleic acid after digestion.

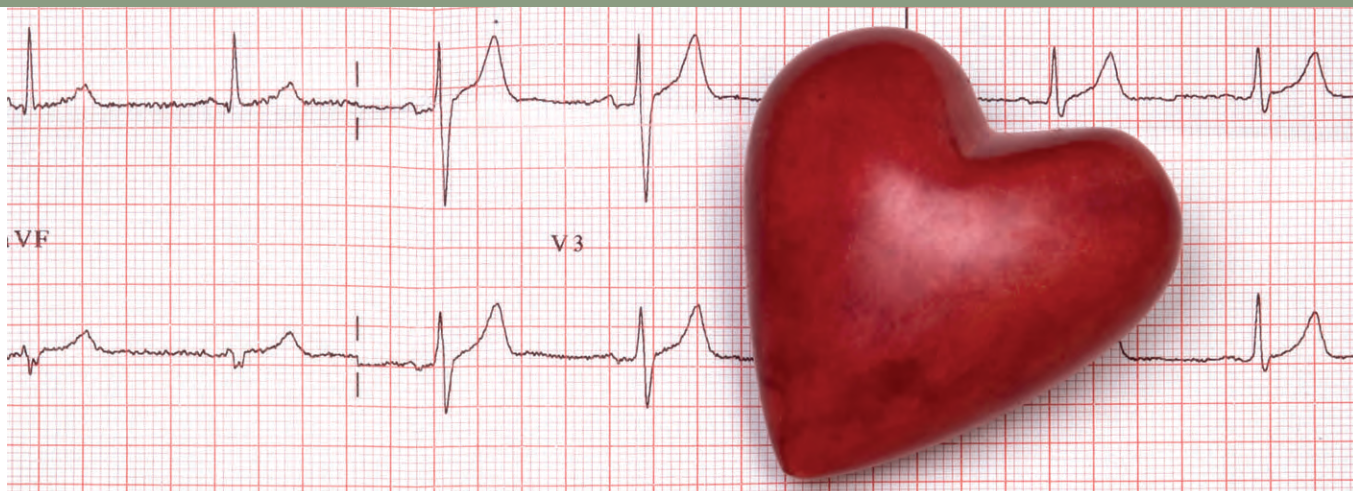
A theory was formulated that stearic acid might not increase risk of CVD because it was quickly converted to oleic acid and acted more like an unsaturated fat with respect to its effect on cholesterol. If correct, this would be an attractive proposition—a functional solid fat that is believed not to affect risk of CVD. But new research was about to cast doubt on that theory.

In the 1990s, two independent research groups set out to prove that stearic acid was rapidly converted to oleic acid after consumption by humans. One study was carried out by scientists at the US Department of Agriculture (USDA) using  $^{13}\text{C}$ -labeled stearic acid, and a second independent study, by Rhee and coworkers (1997) at Cornell University (Ithaca, New York, USA) using deuterium ( $^2\text{H}$ )-labeled fatty acids. Stable isotope ( $^{13}\text{C}$  or  $^2\text{H}$ ) labeling allows the metabolic fate of a substance to be accurately tracked throughout the body. But the USDA found that less than 10% of the stearic acid was converted to oleic acid, and Cornell researchers found just over 10% of the stearic acid was converted. These studies clearly show that stearic acid is not converted to oleic acid in significant quantities in humans and that stearic acid is not oleic acid “in disguise.”

The second problem with the stearic acid theory was its reliance on the diet-heart hypothesis, that the risk of CVD was solely dependent on total cholesterol or LDL cholesterol. As already mentioned, HDL cholesterol was found to have the opposite effect on CVD to LDL cholesterol. By the end of the 1990s, many studies on stearic acid and other fatty acids in humans included measurements of HDL cholesterol as well as total and LDL cholesterol. The landmark 2003 study conducted by Ronald P. Mensink and co-workers at Maastricht University in the Netherlands combined the results of 60 carefully controlled dietary studies into a meta-analysis. Combining studies in this way gives a more reliable picture of a research field than selecting single studies.

The meta-analysis confirmed earlier research that LDL cholesterol and total cholesterol were not increased by consumption of stearic acid. But the study also revealed that stearic acid did not increase levels of serum HDL cholesterol. This was a significant finding because all of the other saturated fats (palmitic, myristic, and lauric) were found to increase HDL levels, along with their well-known LDL-raising effect. *Trans* fat did not raise serum HDL, but it did raise LDL significantly. There was no significant difference in total/HDL ratios between subjects on a high stearic acid diet or on a high palmitic acid diet indicating there is no difference in risk of CVD between these fatty acids.





Subsequent to the publication of the Mensink meta-analysis, the USDA Beltsville (Maryland) Human Nutrition Research Center undertook to perform the largest and most carefully controlled dietary study to date that compares stearic acid with other dietary saturated fats. It confirmed that stearic acid does not raise HDL cholesterol, and that a combination of other saturated fats (palmitic, myristic, and lauric) does raise HDL. Consumption of stearic acid resulted in slightly higher total/HDL ratios than for the other saturates tested. The USDA study, which appeared in 2002, also found that stearic acid increased a marker of inflammation, an effect not seen for other saturates. Emerging science indicates that increased background inflammation may be associated with increased risk of CVD. Some other studies have not found increased inflammation with stearic acid intake at lower levels. However, with the advent of products and modified oilseeds containing higher levels of stearic acid, dietary intake of stearic acid is likely to increase significantly, suggesting the impact of stearic acid on inflammation deserves further research.

Direct evidence linking stearic acid and other saturated fats with actual incidence of CVD is lacking. The Nurses' Health Study, a large observational study led by researchers at the Harvard School of Public Health, attempts to correlate intake of various dietary components over many years with incidence of various diseases, including heart disease. In 1999, data were published comparing the effect of palmitic and stearic acids on the incidence of CVD, but no difference between the fats could be found. Although this finding corresponds with the total/HDL ratio predictions, much more research using controlled intervention studies with CVD as an end point are needed before a direct relationship between individual saturated fats and incidence of CVD can be established.

Palmitic acid is present in the human diet at approximately a 2:1 ratio compared with stearic acid. It is the primary product of fat synthesis in the human body and is incorporated into most of our cell membranes. As discussed above, dietary palmitic acid is believed to differ from dietary stearic acid with respect to its effect on serum cholesterol components. The Mensink meta-analysis of 60 studies showed that consumption of palmitic acid resulted in higher serum levels of both HDL and LDL cholesterol compared with stearic acid. Higher levels of serum HDL are believed to protect against risk of CVD, and the increased HDL level should be seen as a rationale for offsetting potential risk from an increase in serum LDL. The resulting total/HDL ratios for palmitic and stearic acids are not statistically different,

which predicts there is no difference in risk of CVD between palmitic and stearic acids. The carefully controlled USDA study (2002) showed a slightly lower total/HDL ratio for a blend of palmitic and lauric acids compared with stearic acid. Finally, the Nurses' Health Study could not find any difference in risk of CVD between palmitic and stearic acids.

Overall, there is little or no evidence that palmitic and stearic acids differ with respect to risk of CVD. This is due not only to the different effects these fats have on total and LDL cholesterol but also to the beneficial effect of palmitic acid on HDL cholesterol, which is absent with stearic acid. This absence of a difference is further reinforced by the fact that dietary stearic acid is not significantly converted to oleic acid in humans. But the total/HDL ratio seen with both palmitic and stearic acids implies that there would be little effect on the risk of CVD from either saturated fat. This biochemical assessment is validated by a growing body of epidemiological data suggesting that saturated fat in general may not be as bad as once believed.

Gerald McNeill is director of research and development for Loders Crokiaan NA in Channahon, Illinois, USA. He can be reached at [gerald.mcneill@crokiaan.com](mailto:gerald.mcneill@crokiaan.com).

## information

### For further reading:

- Judd, J.T., D.J. Baer, B.A. Clevidence, P. Kris-Etherton, R.A. Muesing, and M. Iwane, Dietary *cis* and *trans* monounsaturated and saturated FA and plasma lipids and lipoproteins in men, *Lipids* 37:123–131 (2002).
- Mensink, R.P., P.L. Zock, A.D.M. Kester, and M.B. Katan, Effects of dietary fatty acids and carbohydrates on the ratio of serum total to HDL cholesterol and on serum lipids and apolipoproteins: a meta-analysis of 60 controlled trials, *American Journal of Clinical Nutrition* 77:1146–1155 (2003).
- Rhee, S.K., A.J. Kayani, A. Ciszek, and J.T. Brenna, Desaturation and interconversion of dietary stearic and palmitic acids in human plasma and lipoproteins, *American Journal of Clinical Nutrition* 65:451–458 (1997).

# Oilseeds of the future: Part 2

Catherine Watkins

inform's examination of some of the trait-modified oilseeds currently in research and development pipelines around the world continues with this month's look at work in cottonseed, flax, and oil palm.

## COTTONSEED (*Gossypium*)

Commonwealth Scientific and Industrial Research Organisation (CSIRO), Canberra, Australia

**What:** Canola and cotton (*Gossypium hirsutum*) plants engineered to produce oil containing eicosapentaenoic (EPA) and docosahexaenoic (DHA) fatty acids, the omega-3 long-chain polyunsaturated fatty acids (LC-PUFA) found in cold-water fish and algal oils.

**How:** Genetic modification: Food Futures National Research Flagship researchers have taken key LC-PUFA genes from marine microalgae, a form of lower plant, and transferred them to land plants. "In a world first, the team was able to demonstrate synthesis of the key nutritionally active omega-3 LC-PUFA, EPA and DHA, in the seed oil of the model oilseed plant *Arabidopsis thaliana*," CSIRO's Surinder Singh explains. Following this key breakthrough, the team has been working to transfer an optimized group of microalgal omega-3 LC-PUFA encoding genes into canola and cotton.

**Benefits:** The primary sources of omega-3 LC-PUFA in the human diet are fish and marine algae. Two trends indicate that there is an urgent need for novel sources of omega-3 LC-PUFA in the diet. First, the awareness of the need to increase one's intake of omega-3 LC-PUFA is growing among consumers, health professionals, and the food industry, leading to a steadily increasing demand. Second, fish-derived sources of omega-3 LC-PUFA are under pressure because of the need to conserve and manage marine ecosystems. "Algal sources of omega-3 LC-PUFA are very expensive and unlikely to supply the expected demand," Singh suggests.

Canola or cottonseed oil containing EPA and DHA can revolutionize the ability of agrifood industries to deliver the nutritional benefits of LC-PUFA. For example, this type of oil can be used directly to produce omega-3-enriched margarines, fish and animal feeds, as an ingredient in other processed foods, as a nutritional supplement (such as in infant formula), and in specialized nutraceutical applications and will go a long way in meeting the projected worldwide increase in demand for omega-3 LC-PUFA.

**When:** The technology has progressed beyond proof-of-concept stage. Commercial production of omega-3 LC-PUFA canola and/or cottonseed is targeted to begin in 2015.

**Samples:** Samples are not available currently. No date has been set for their availability.

**Contact:** Surinder Singh, group leader, Oilseeds Group (surinder.singh@csiro.au).

CSIRO, Canberra, Australia

**What:** High-oleic cottonseed (*Gossypium hirsutum*) that is also low in saturates and cyclopropenoic fatty acids (CPFA).

**How:** Genetic modification involving silencing of endogenous fatty acid biosynthetic genes and introduction of novel fatty acid biosynthesis genes. In cottonseed, RNAi-mediated gene silencing has been used to down-regulate the synthesis of palmitic acid, CPFA, and PUFA, resulting in an oil that is highly enriched for oleic acid and reduced in nutritionally undesirable saturates and CPFA.

**Benefits:** The high-oleic cottonseed oil has greatly enhanced oxidative stability and improved nutritional value. It could replace hydrogenated oils in food service frying applications, thereby avoiding use of oils with *trans* fatty acids, and may open up the possibility of a retail bottled cottonseed oil for household use. This development will also provide additional crop production opportunities and potentially higher value for oilseed growers.

**When:** High-oleic cottonseed is undergoing product evaluation as a prelude to a decision to develop commercial varieties. It could be brought to market within five to seven years.

Rows of no-till cotton grown in a USDA test plot.



Photo by David Nance. Courtesy of the US Department of Agriculture.



**Samples:** Will be available for evaluation within a year.  
**Contact:** Allan Green, program leader of the Metabolic Engineering of New Plant Products team (Allan.Green@csiro.au).

*Southern Plains Agricultural Research Center (SPARC), Agricultural Research Service (ARS), US Department of Agriculture (USDA), College Station, Texas, USA*

**What:** “Cottonseed provides a high-quality protein that currently is underutilized because of the presence of the toxic compound called gossypol,” Robert Stipanovic of SPARC writes. Gossypol occurs in the plant as enantiomers. The enantiomeric ratio in commercial cottons is approximately three parts (+)-gossypol and two parts (–)-gossypol. (–)-Gossypol is toxic to nonruminant animals, but (+)-gossypol is not toxic. Cottonseed with a (+)-to (–)-gossypol ratio that is >9:1 can be safely fed to poultry, and by extension to other nonruminants such as swine and fish. The Brazilian “moco” cotton cultivars (*G. hirsutum* var. *marie galante*) exhibit ratios of (+)-to (–)-gossypol as high as 98:2. Moco cotton does not produce bolls until the second year and thus is grown as a perennial in Brazil. Using traditional breeding techniques, SPARC incorporated this high (+)-gossypol seed trait into cotton plants with fiber quality and yields that are comparable to commercial cotton varieties.

**Benefits:** This high (+)-gossypol seed could be used to partially replace poultry feeds such as corn that are currently being diverted for gasohol production.

**When:** SPARC has completed two years of field testing of some lines that produce ~95% (+)-gossypol in seed. “We plan to do a germplasm release in 2010 and hope oil will be available for use by the food industry in 2012,” Stipanek notes.

**Samples:** Available with germplasm release in 2010.

**Contact:** Alois A. Bell, research plant pathologist (al.bell@ars.usda.gov).

*Southern Regional Research Center (SRRC), ARS, USDA, New Orleans, Louisiana, USA*

**What:** Michael K. Dowd of SRRC reports that ARS scientists are conducting preliminary work to study what variation in fatty acid compositional properties might be bred into cottonseed. “As a first step, the roughly 9,000 available accessions in the US GRIN Cotton Collection are being screened for fatty acid composition. Traits of interest include reducing the cyclopropenoid fatty acid content, reducing the proportion of saturated fatty acids, and increasing the ratio of oleic to linoleic acids,” he notes. Researchers are also studying the variation in current agronomic cotton cultivars and the effect of environment on cottonseed fatty acid composition. “Of course, these efforts must not negatively affect cotton fiber properties, which makes this effort more difficult than similar efforts in other oilseeds,” he notes.

**How:** Work is preliminary to see what variation in fatty acids exists in cotton germplasm. If traits of interest are found, breeding strategies will then be developed.

**Contact:** Michael K. Dowd (Michael.Dowd@ars.usda.gov).



Courtesy SaskFlax, Flax Council of Canada FC2015 Inc.

## FLAX (*Linum usitatissimum*)

*Agriculture and Agri-Food Canada, Morden, Manitoba, Canada*

**What:** “The traits that are of prime importance to our breeding program are yield and lodging resistance; oil,  $\alpha$ -linolenic acid, and protein content; as well as disease resistance to fusarium wilt, rust resistance, and powdery mildew,” notes Scott Duguid of Agriculture and Agri-Food Canada. “In the case of the seed quality traits, we have increased the oil content of flax up to 50% on a dry basis and  $\alpha$ -linolenic acid up to 59–60%, and improved protein content in the meal in the range of 47–49%,” he reports.

**How:** Conventional breeding.

**Benefits:** By increasing the overall oil and  $\alpha$ -linolenic acid content of flax, consumers will benefit from a more healthful oil and increased  $\alpha$ -linolenic acid in the seed and/or ground seed. In addition, flax oil and/or seed likely will be utilized in more food products. Increased utilization of the seed and meal of flax in cattle, swine, and poultry feeds also is likely. “This should provide new opportunities for oilseed processors not only to increase the amount of oil available as a result of increased oil and improved  $\alpha$ -linolenic acid content but also to have increased marketing opportunities because of the improved protein content in the meal,” Duguid writes.

**When:** Seed of these improved varieties already is available and is being marketed as Prairie Thunder, Shape flax, and FP2214. Oil is expected to be available for use by the food industry in two or three years.

**Samples:** Samples are available now.

**Contact:** Scott D. Duguid, research scientist (Scott.Duguid@agr.gc.ca).

## OIL PALM

*Malaysian Palm Oil Board (MPOB), Bandar Baru Bangi, Kajang, Selangor, Malaysia*

**What:** High-oleic (with reduced palmitic acid) and high-stearic acid palm oils.

**How:** Genetic modification.

**When:** Transgenic plants currently are available in biosafety screenhouses, with commercial planting expected by 2025.

**Samples:** Oil samples are expected to be available in 2013.

**Contact:** Ahmad Parveez Ghulam Kadir (parveez@mpob.gov.my).

*MPOB, Bandar Baru Bangi, Kajang, Selangor, Malaysia*

**What:** Breeding populations for the following traits have been developed: high iodine value for high oil unsaturation, high carotene for the nutraceutical industry, high vitamin E as a source of antioxidants, high oleic acid for high oil unsaturation, and low lipase for maintenance of oil quality.

**How:** Conventional breeding.

**When:** Breeding populations for the production of planting materials with the above traits are already available for uptake by industry. Currently, only the high-iodine value planting material is available commercially. For the other traits, current production at MPOB is mainly for research and development (progeny testing and field evaluation). Uptake of the breeding materials by industry



Courtesy Malaysian Palm Oil Board

*Genetically modified oil palm in a biosafety screenhouse.*

would be required for commercial production of the planting materials.

**Samples:** Samples could be prepared and made available for evaluation subject to clearance from MPOB management.

**Contact:** Mohd Din Amiruddin (mohddin@mpob.gov.my).

*Catherine Watkins is associate editor of inform. She can be reached at [cwatkins@aocs.org](mailto:cwatkins@aocs.org).*

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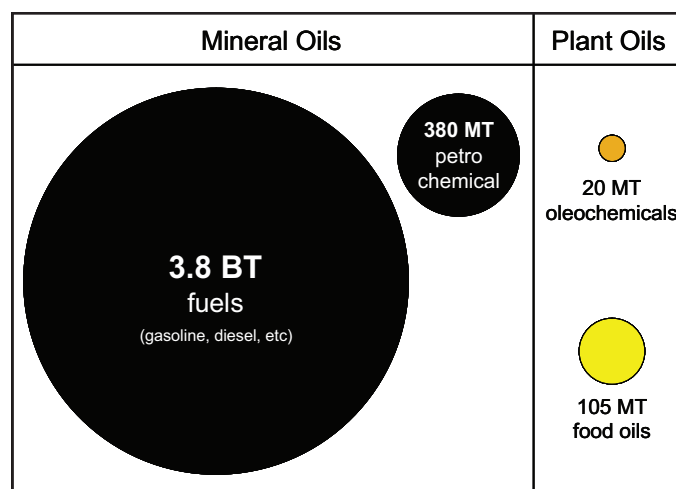
## Australian oilseed industry gears up for the future bio-industrial economy

Allan Green, Mike O'Shea, Louise Lawrence, and Cameron Begley

Modern society relies heavily on petroleum as a source of many industrial products ranging from fuels and lubricants to specialty chemicals and plastics. But petroleum reserves are finite and, as supply constraints emerge, alternative raw materials to support these industrial needs are gaining increasing strategic importance. Plant oils represent one of the main opportunities to provide environmentally friendly, renewable, and sustainable feedstocks that can potentially substitute for petroleum in many applications. To date, most of the focus has been on using plant oils for biodiesel, providing an alternative source of energy particularly for liquid transport fuel applications. Unfortunately, in spite of their technical suitability for this purpose, plant oils cannot be produced on sufficient scale to make a major contribution to the immense global demand for transport fuels (Fig. 1). In the long term, this need must instead be addressed by a mix of other approaches, including the introduction of a range of alternative energy technologies that are both sustainable and scaleable.

Petroleum, however, is used not only for fuel—it is a source of a diverse array of carbon-based molecules (petrochemicals) that are the foundation of the industrial chemical and polymer sectors. Diminishing petroleum availability also impacts the manufacture of these products. The search for renewable biobased materials is now under way, and this is an area where plant oils can have a much greater impact. Global plant oil production is running at around 125 million metric tons annually—around a third of the size of petrochemical production (Fig. 1)—indicating that plant-based oils can be produced on a scale that could have a significant industrial chemical impact.

Australian farmers have already recognized this opportunity and have begun to develop specialty oilseeds that can supplement and eventually replace petrochemicals in targeted high-value industrial applications. In 2004 the Australian Grains Research and Development Corporation (GRDC) joined forces with the CSIRO (Commonwealth Scientific and Industrial Research Organisation), Australia's premier government research agency, to establish their Crop Biofactories Initiative (CBI). CBI aims to engineer oilseeds with fatty acid compositions that match specific industrial applications, to establish the matching materials science technologies, and ultimately to launch production and processing value chains within Australian agribusiness. This significant strategic step builds on Australia's increasing acceptance of the production of genetically modified (GM) oilseeds. GM cottonseed has been produced in Australia for over a decade, and the recent introduction of GM canola is being embraced by growers. With its large and diverse cropping regions, an established history of successful production of a range of grain quality segregations, and experience in developing and implementing protocols for managing the



**FIG. 1.** Indicative relative scale of global mineral oil and plant oil production and utilization in 2006 (data from *Oil World Annual 2008* and US Department of Energy, Energy Information Administration website). MT, Million metric tons; BT, Billion metric tons

coexistence of current GM and non-GM crops, Australian agriculture is well placed to diversify into GM industrial crops.

## INDUSTRIAL CROP PLATFORMS

Introduction of industrial crops into our food crop production and processing systems requires considerable care and management to avoid cross-contamination of products. Therefore, CBI viewed it as critical that the oilseed crop chosen as a platform for novel industrial products not already be a significant food crop within Australia. This consideration removed canola, soybean, and sunflower as options. It was also thought that the “new” oilseed crops being considered in other countries—such as *Crambe abyssinica*, *Brassica carinata*, and *Camelina sativa*—were not, at least at this stage, sufficiently developed or proven in their Australian adaptation to be relied on as a crop biofactory platform. Instead, CBI has chosen safflower (Fig. 2) as its platform crop for industrial oil production in Australia. Although used as a food crop in some parts of the world, safflower is currently a relatively minor and underutilized crop in Australia. It has good seed yield, high oil content, and well-understood agronomy—features that are lacking in many other nonfood crops that are considered candidates for industrial oil production. It is also widely adapted to Australian growing regions and has a flexible planting window, providing versatile crop production options. CBI considers that, in an Australian

CONTINUED ON NEXT PAGE

context, production of an industrial safflower crop can reach significant scale and still remain clearly isolated from the food-grade safflower crop.

## ENGINEERING NOVEL OIL COMPOSITIONS

Although some oil crops are already sources of fatty acids with specialty industrial uses—such as lauric from coconut and palm kernel oils, ricinoleic from castor bean oil, eleostearic from tung oil—their production capacity is limited and often erratic. To reliably provide the future raw material needs of the industrial chemistry sector, it will be necessary to develop large-scale, high-yield production of a wider range of fatty acids closely matched to their end uses, such as in the production of plastics, adhesives, and surface coatings. In this regard, there is great capacity to genetically engineer plant oils to contain novel, industrially useful fatty acid structures (Dyer *et al.*, 2008). Although most of our current oil crops contain only a limited number of relatively simple fatty acids—those suitable for cooking and eating—in nature, plants produce a vast array of fatty acid structures, many of them able to emulate the properties of today's petrochemicals, or to enable new industrial chemistries. Unfortunately these wild plants are low yielding and unsuitable for agriculture, but they do provide a valuable genetic resource to enable the engineering of commercial oil crops to produce these fatty acids.

One CBI research team, led by Allan Green at CSIRO Plant Industry, is developing technologies to engineer oilseeds to synthesize a range of these unusual fatty acids (UFA), such as epoxygenated, hydroxylated, and acetylenated fatty acids. This work faces two key challenges—engineering the



**FIG. 2.** Safflower has been chosen by the Australian Crop Biofactories Initiative as its primary crop platform for specialty industrial oils.



**FIG. 3.** *Bernardia pulchella*, a wild species containing over 90% epoxy fatty acids in its seed oil.

plant to synthesize the UFA in the first place, and then ensuring that they are accumulated in the seed oil at the very high concentrations needed for industrial feedstock use. Genes for synthesis of several of these UFA have been available for some time now, but when expressed transgenically in seeds they have generally yielded disappointingly low levels of the target product in the oil, even though the plant from which the gene was sourced may accumulate more than 90% of the UFA. For example, expression of the  $\Delta 12$ -epoxygenase gene from *Crepis palaestina* in *Arabidopsis* initially resulted in less than 10% vernolic acid (a  $\Delta 12$  epoxy fatty acid) being accumulated in the seed oil (Zhou *et al.*, 2006).

To overcome this impediment, CBI researchers have now returned to the wild plants—this time to *Bernardia pulchella* (Fig. 3), a species that contains over 90% vernolic acid—aiming to discover the additional genes responsible for very high-level UFA accumulation. At the International Symposium on Plant Lipids in Bordeaux in July 2008, CBI researchers reported a major advance in doubling the accumulation of vernolic acid in *Arabidopsis* by addition of the *Bernardia* gene for the DGAT2 (diacylglycerol acyltransferase 2) enzyme, the important final step that converts diglycerides to triglycerides. Their aim now is to reconstitute in safflower a complete biosynthetic pathway for synthesis of UFA-rich triglycerides to produce a highly enriched UFA source without prohibitive separation costs.

## NEW OILS ENABLE NEW MATERIALS

Another CBI team, led by Mike O'Shea at CSIRO Molecular and Health Technologies, is exploring how UFA can be used in current industrial applications or as components of novel biobased polymers. One area of focus has been on developing applications for alpha-hydroxy fatty acids. Saturated alpha-hydroxy acids (AHA) are well known to industry, but the CBI scientists have found some interesting applications for the unsaturated forms (AHU) and are learning how these affect polymer properties. By incorporating derivatives of AHU into a range of polymers and biopolymers, members of the research team have produced polyesters and polyamides with significantly improved flexibility (as measured by elongation to break) and fibers and films with greater tear resistance. At the recent 100th AOCS Annual Meeting, the research team reported their discovery that the lactides of AHA and AHU are an ideal system to modify condensation polymers (such as Nylon or PLA—polylactic acid) with a minimal loss of molecular weight (Graichen *et al.*, 2009). Promising results in the

## information

### For further reading:

- Dyer, J.M., S. Stymne, A.G. Green, and A.S. Carlsson, High value oils from plants, *Plant Journal* 54:640–655 (2008).
- Zhou, X.R., S. Singh, and A. Green, Engineering oilseeds to produce unusual fatty acids, *Lipid Technology* 18:199–203 (2006).
- Graichen, F.H.M., S. Kyi, G. Peeters, and M.S. O'Shea, Investigation, production and uses of novel hydroxylated fatty acids, Abstract, 100th AOCS Annual Meeting & Expo, Orlando, Florida, USA, May 5, 2009.



modification of polyesters and polyamides were also achieved through the use of oligomeric lactones of ricinoleic acid and of omega-hydroxy fatty acid lactones. The modified polymers display a low haze rating across a range of addition rates and have the advantage of covalent incorporation. Using these AHU, the team members have also observed strong adhesion between polyolefins and a range of substrates. For example, they have produced a biobased adhesive that shows promising adhesion for polyethylene and polypropylene, two plastics that are notoriously difficult to stick together.

The group's research has also uncovered a new class of fatty acids, alpha-hydroxy polyacetylenic fatty acids, which open up entirely novel chemistries. Acetylenic and polyacetylenic fatty acids with unique properties have been known for some time, but their use to date has been restricted to a limited range of higher-value industrial applications owing to their prohibitive cost. Currently, these fatty acids are made through entirely synthetic means. However, the CBI program is looking at alternative production routes—either fully biological or a combination of biological and synthetic processes. Team members are also exploring their potential for wider application as production costs are lowered. Promising applications so far uncovered include their use as indicators for a range of different conditions, such as mechanical stress or heat (some change color when exposed to these stresses). They also display self-assembly features and, in some cases, antimicrobial properties and potential for use in biosensors for detecting bacteria, viruses, and the like. Although CBI already has conventional synthetic chemistry production routes

for these families of compounds, the challenge is to enable their production in price-competitive, renewable, and sustainable production systems, which comes back to the CBI focus on producing such compounds in biofactories.

Finding sustainable alternatives to petroleum to supply the global needs for industrial chemicals is indeed a challenging goal, but it is one that must be tackled to overcome the long-term deteriorating petroleum supply and cost situation. No doubt a range of alternatives will come about, including conversion of biomass to chemicals through biorefineries. However, plant oils promise to make a major contribution to this goal, through expanded production and introduction of dedicated industrial oil crops. The full potential of plant oils to meet the specific raw material requirements of industry will be realized only through their genetic manipulation to contain high concentrations of particular unusual fatty acids specifically matched to target industrial uses.

*Allan Green, Mike O'Shea, Louise Lawrence, and Cameron Begley are employed by CSIRO Australia, PO Box 1600, Canberra, ACT 2601. Green may be contacted at [Allan.Green@csiro.au](mailto:Allan.Green@csiro.au).*



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# Codex Alimentarius Commission update

Catherine Watkins

AOCS Technical Director Richard Cantrill attended recent meetings of two Codex Alimentarius Commission (Codex) committees that deal with issues of interest to the fats and oils industry. Topics discussed included work to update the standard on named vegetable oils, amendments to the standard on olive oil, the code of practice for the storage and transport of edible fats and oils in bulk, and evaluation of accepted methods of analysis and sampling for the detection of foods derived from biotechnology.

"As a global provider of methods of analysis, AOCS is pleased to support its members by ensuring that the relevant methods are referenced in Codex standards," Cantrill said. "Codex recognizes the value of consensus-driven standards development and the work of Nongovernmental Organizations (NGOs) in the food quality/safety arena."

## CODEX COMMITTEE ON FATS AND OILS

The 21st Session of the Codex Committee on Fats and Oils (CFO) was held February 16–20, 2009, in Kota Kinabalu, Malaysia.

Approximately 110 delegates attended from 38 countries and seven nongovernmental organizations.

At this meeting, the committee agreed to:

- advance to Step 8 the Draft Amendment to the Standard for Named Vegetable Oil: Inclusion of Rice Bran Oil. Following a final round of comments, it is expected the standard will be adopted by Codex.
- advance to Step 5 the Proposed Draft Criteria to Assess the Acceptability of Substances for Inclusion in a List of Acceptable Previous Cargoes. The criteria were developed in November 2007 in a special consultation by FAO (UN Food and Agriculture Organization) and have been reviewed at two CFO sessions.
- advance to Step 5 the Proposed Draft Amendment to the Standard for Named Vegetable Oil: Inclusion of Palm Kernel Olein and Palm Kernel Stearin.
- propose to discontinue work on the amendment to the Standard for Named Vegetable Oils on total carotenoids in unbleached palm oil. The CFO previously had been unable to reach consensus on the amendment because of lack of data; work undertaken by Indonesia indicated that low total carotenoid levels in unbleached palm oils were associated with varieties of less significance to the production of palm oil in Indonesia, and so the proposed amendment was withdrawn.
- propose a revised list of additives in the standards for fats and oils for endorsement by the Committee on Food Additives and adoption by the Commission.
- request the Commission to approve the amendment to the section on Contaminants in the Standard for Named Vegetable Oils to replace it with the standard language in the Format for Codex Commodity Standards.

The CFO also agreed to:

- retain at Step 7 the Draft List of Acceptable Previous Cargoes and to return to Step 3 the Proposed Draft List of Acceptable Previous Cargoes (essentially, a list of items not included in the draft list) for comments and consideration at the next session.
- return to Step 3 the Proposed Draft Amendment to the Standard for Olive Oils and Olive Pomace Oils on the level of linolenic acid and related footnote. The standard—33-1981 (Rev. 2–2001)—was made final in 2003. Since then, the maximum level of  $\alpha$ -linolenic acid has been a subject of debate. The discussion revolves around issues of the quality and authenticity of olive oils; if no progress is made at the next CFO meeting, the work on the proposed draft amendment will be discontinued.
- not consider further the proposal for future work on the composition and naming of fatty acid-modified vegetable oils.

## information

### For further reading:

- Codex List of Current Standards—[www.codexalimentarius.net/web/standard\\_list.jsp](http://www.codexalimentarius.net/web/standard_list.jsp)
- Codex Committee on Contaminants in Foods—final report: [www.codexalimentarius.net/download/report/722/al32\\_41e.pdf](http://www.codexalimentarius.net/download/report/722/al32_41e.pdf)
- Codex Committee on Fats and Oils—final report (February 16–20, 2009 meeting): [ftp://ftp.fao.org/codex/Alinorm09/al32\\_17e.pdf](http://ftp.fao.org/codex/Alinorm09/al32_17e.pdf)
- Codex Committee on Methods of Analysis and Sampling—final report (March 9–13, 2009 meeting): [www.codexalimentarius.net/web/archives.jsp](http://www.codexalimentarius.net/web/archives.jsp)
- *Development of Criteria for Acceptable Previous Cargoes for Fats and Oils*, November 2007, 63-page free e-book available at [www.fao.org/docrep/010/a1090e/a1090e00.htm](http://www.fao.org/docrep/010/a1090e/a1090e00.htm)
- International Organisations Working in the Field of Methods of Analysis and Sampling—final report: [www.aocs.org/meetings/iam](http://www.aocs.org/meetings/iam)



## THE CODEX STEP PROCESS

**Step 1**—A project proposal for new work prepared by a Codex subsidiary body is reviewed by the Executive Committee and compared against the criteria and priorities established by the Commission. The proposal is then referred to the Commission for approval as a new standard, guideline, or related text for development. The Commission approves and decides who will undertake work.

**Step 2**—The Secretariat arranges for the preparation of a proposed draft standard. This may be through a working group of the relevant committee, an international organization, or other expert bodies.

**Step 3**—The draft text is circulated to member governments and relevant international organizations for comment.

**Step 4**—Comments are reviewed at Committee level and incorporated into the draft standard for discussion.

**Step 5**—The Commission reviews the progress made and determines whether the draft standard should be made final. Sometimes the text is considered to be ready for final adoption at this stage, which is then called Step 5/8.

**Step 6**—The approved draft is circulated to member countries for another round of comments and put into final form by the relevant Committee.

**Step 7**—Amendments are made by the committee to the revised draft based on comments received and the proposed standard is referred to the Commission for adoption.

**Step 8**—Following a final round of comments, the Commission adopts the draft as a formal Codex text. The standard, guideline, or other text is then published by the Codex Secretariat.

Courtesy Cognis

The 22nd Session of the Codex Committee on Fats and Oils has been scheduled to be held in Malaysia in February 2011. The venue and date are yet to be determined. The agenda for the meeting is available at [www.codexalimentarius.net/web/current.jsp?lang=en](http://www.codexalimentarius.net/web/current.jsp?lang=en).

## CODEX COMMITTEE ON METHODS OF ANALYSIS AND SAMPLING

The 30th Session of the Codex Committee on Method of Analysis and Sampling (CCMAS) was held March 9–13, 2009, in Balatonalmádi, Hungary, with 150 participants from 30 countries and eight NGOs. CCMAS defines criteria for Codex methods of analysis and sampling and coordinates the work of Codex with other international groups working in methods of analysis and sampling and quality assurance systems for laboratories.

CCMAS also specifies reference methods of analysis and sampling for Codex Standards and considers and endorses methods of analysis and sampling proposed by Codex committees, except those related to pesticide residues and veterinary drugs in food, the assessment of microbiological quality and safety in food and food additives. It also considers issues submitted to it by the Codex Alimentarius Commission and defines procedures, protocols,

and guidelines for quality assurance systems and assessment of proficiency for food laboratories.

At the session the committee agreed to:

- advance to Step 8 the Draft Guidelines for Settling Disputes on Analytical (Test) Results.
- advance to Step 8 the Draft Guidelines on Analytical Terminology.
- endorse or update the status of several methods of analysis in Codex Standards.
- propose a consequential amendment to the Working Instructions for the Implementation of the Criteria Approach in Codex in the Procedural Manual.
- discontinue work on the Draft Guidelines for Evaluating Acceptable Methods of Analysis.
- return to Step 2/3 the Proposed Draft Guidelines on Criteria for Methods for the Detection and Identification of Foods Derived from Biotechnology. CCMAS first considered the possible expansion of the scope of the guidelines. Some delegations felt they should apply not only to genetically modified materials but also to a wide range of food safety issues such as allergens, contaminants, and pathogens. Other delegations opposed the expansion in scope. CCMAS members noted that there was “an urgent need for technical guidance on methodology

applied to genetically modified foods and a need to facilitate harmonization at the international level.”

Cantrill noted that the work program of ISO/TC 34/SC 16 “Horizontal Methods for Molecular Biomarker Analysis” (see *inform* 19:603–604, 2008) would produce guidelines and validated methods for molecular biomarker analysis.

After further discussion, CCMAS returned the text to Step 2 and established an electronic working group, co-chaired by Argentina and the United Kingdom, to revise the proposed draft guidelines. The revised text will be circulated for comments at Step 3 and will be considered at the next CCMAS session.

- return to Step 2/3 the Proposed Draft Revised Guidelines on Measurement Uncertainty.
- consider further at its next session guidance on uncertainty of sampling and the methods of analysis for natural waters.

The 31st Session of the Codex Committee on Methods of Analysis and Sampling will be held in Hungary, March 2010. The agenda is available at [www.codexalimentarius.net/web/current.jsp](http://www.codexalimentarius.net/web/current.jsp).

## INTERAGENCY MEETING

Cantrill also attended the 21st meeting of the International Organizations Working in the Field of Methods of Analysis and Sampling (IAM). AOCS is secretariat for the group, which met March 6 in Budapest. Attendees included representatives from various international standard-setting organizations.

A meeting of experts was convened in the framework of the ISO International Workshop Agreement on Sampling to attempt to rationalize existing international standards for sampling grain and oilseeds. As a result, a modification of ISO/DIS 24333 with

The Codex Alimentarius Commission (CAC; Rome, Italy) was established in 1963 by the Food and Agricultural Organization of the United Nations (FAO) and the World Health Organization (WHO) to protect the health of consumers and ensure fair practices in food trade through the development of standards, codes of practice, guidelines, and other recommendations relating to foods, food production, and food safety.

The *Codex Alimentarius* (Latin for “food code”) is the result of the work of the Commission and its almost 20 technical committees. The *Codex Alimentarius* is recognized by the World Trade Organization as an international reference point for the resolution of disputes concerning food safety and consumer protection.

that are working together to help food manufacturers, retail outlets, and regulatory bodies cope with the challenges posed by a globalized food economy.)

The International Union of Pure and Applied Chemistry and MoniQA are undertaking some modeling exercises concerning the validation of qualitative methods; some of the results were presented to the IAM/MoniQA workshop. The IAM also considered the question of the availability of reagents and concerns related to the proprietary nature of monoclonal antibodies and whether these restricted the development of rapid methods of detection in some areas

The next meeting of the IAM will be held prior to the 31st Session of the CCMAS in March 2010.

## OTHER CODEX NEWS

The Third Session of the Codex Committee on Contaminants in Foods (CCCCF) was held on March 23–27, 2009, at Rotterdam, the Netherlands. Four documents from the Committee will go forward to the Commission at Step 8, including:

- General Standards for Contaminants and Toxins in Foods; Code of Practice (COP) for the Reduction of Acrylamide in Food.
- COP for Reduction of Food Contamination with Polycyclic Aromatic Hydrocarbons from Smoking and Direct Drying Processes.
- COP for the Prevention and Reduction of Ochratoxin A Contamination in Coffee.

Other contaminants discussed were total aflatoxins in Brazil nuts, fumonisins in corn and its products, benzene in soft drinks, cyanogenic glycosides, mycotoxins in sorghum, and ethyl carbamate in alcoholic beverages. Proposed new work for this committee includes revising the COP for the Prevention and Reduction of Aflatoxins in Tree Nuts and establishing maximum levels of non-intentional melamine in food and feed and fumonisins in corn and corn products. Sampling remains a key issue in determining the levels of many nonhomogeneously distributed contaminants.

*Catherine Watkins is associate editor of inform. She can be reached at [cwatkins@aocs.org](mailto:cwatkins@aocs.org).*

## Codex recognizes the value of consensus-driven standards development and the work of Nongovernmental Organizations (NGOs) in the food quality/safety arena.

tables representing current dockside and trade practices has been prepared and is in the process of further elaboration.

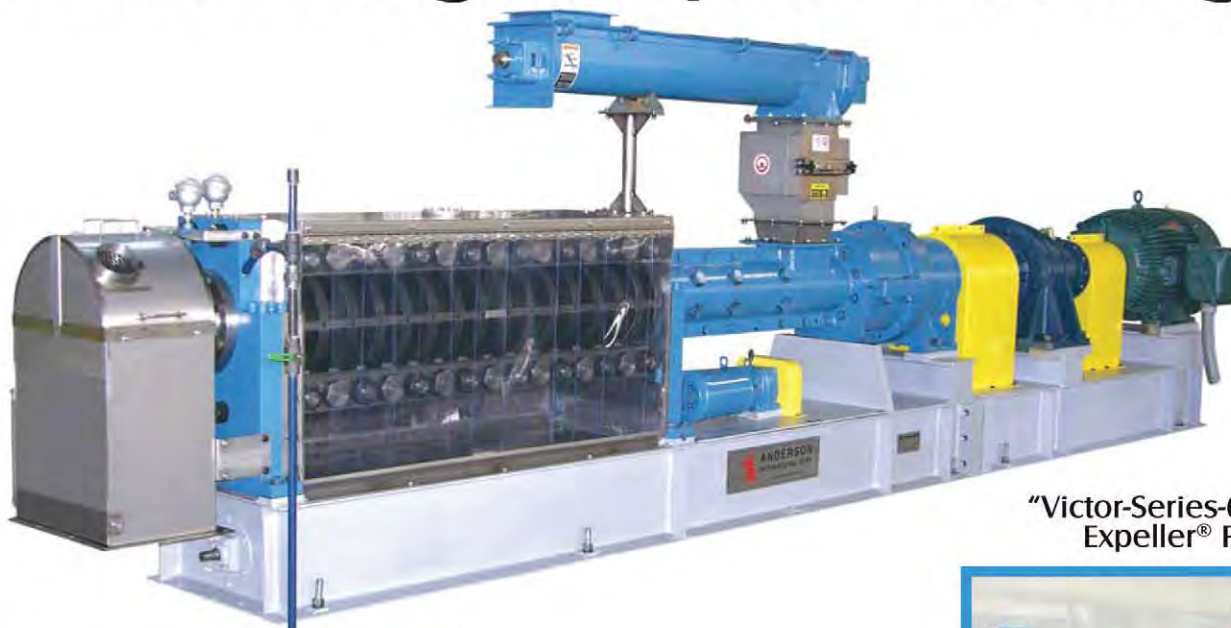
The IAM also considered the criteria approach to methods of analysis selection and agreed that it should not replace the need for official methods of analysis, and that methods should be selected according to the criteria specified in Codex provisions to ensure that they are “fit-for purpose.” IAM recognized that the criteria approach focused on methods of analysis for small molecules and might not be applicable to PCR (polymer chain reaction) and ELISA (enzyme-linked immunosorbent assay) techniques.

IAM and MoniQA (Monitoring and Quality Assurance in the Food Supply Chain) held a workshop in Budapest on March 8, 2009, on the development of methods of analysis and measurement uncertainty, which was attended by many CCMAS delegates. There, Cantrill invited CCMAS participants to make proposals for a future workshop in 2010. (Funded by the European Union, MoniQA brings together 33 organizations from around the world



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## Briefs

Lipid researchers are invited to become members of the new Lipid Division of the American Society for Biochemistry and Molecular Biology (ASBMB; Bethesda, Maryland, USA). The division aims to provide a forum within ASBMB for lipid chemists, biochemists, physiologists, and biophysicists. In addition, the ASBMB Lipid Corner will give lipid researchers "an organized platform for communicating new ideas, emerging concepts and questions, and novel techniques. This new networking web-space will contain information about upcoming meetings, funding opportunities, highlights of recent lipid advances and discoveries, and an interactive forum for online discussions," the group notes on its website at [www.asbmb.org/lipidcorner](http://www.asbmb.org/lipidcorner).

Both members and nonmembers of ASBMB are eligible for membership in the division. Beginning in January 2010, ASBMB nonmember lipid scientists will be eligible for a free one-year membership in both ASBMB and the Lipid Division.



Researchers in the United Kingdom have embarked on a five-year project investigating whether lupins are a viable source of protein in animal feed. (Lupin is the common name for members of the genus *Lupinus* in the legume family [Fabaceae].) Feeding trials have concluded that lupins may be used as a direct replacement for soy meal, because of their high crude protein levels of 30–40%, according to AllAboutFeed.com.



Edible oil manufacturer Adani Wilmar, a 50:50 joint venture between India's Adani Group and Wilmar International of Singapore, plans to increase its refining and oilseed-crushing capacity in the next three years, a top company official told the Press Trust of India news-wire. The company aims to double its refining capacity to 10,000 metric tons (MT)/day and expand its oilseed-crushing capacity to 7,000 MT/day. Current crushing capacity is 6,000 MT/day, and the refining capacity is 5,000 MT/day. ■

# News & Noteworthy



## Annual oilseeds report from Brazil

*The following information is excerpted from the US Department of Agriculture's GAIN Report No. BR9613: 2009 Oilseeds Annual Report. The report was prepared by Agricultural Attaché Elizabeth Autry and is available at [http://gain.fas.usda.gov/Recent%20GAIN%20Publications/Commodity%20Report\\_OILSEEDS%20\\_Brasilia\\_Brazil\\_4-14-2009.pdf](http://gain.fas.usda.gov/Recent%20GAIN%20Publications/Commodity%20Report_OILSEEDS%20_Brasilia_Brazil_4-14-2009.pdf).*

The US Department of Agriculture (USDA) estimates soybean production in 2008/09 in Brazil at 58 million metric tons (MMT) and exports at 25 MMT. Yields have been slightly lower this year, primarily as a result of a drought in the south. Soybean production for 2009/10 is expected to rise to 59.5 MMT, as producers switch some area out of corn and cotton, and export levels are forecast to decrease slightly to 24 MMT. Soybean meal production is expected to be relatively steady, at 24.5 MMT in 2008/09

and 24.7 MMT in 2009/10. Feed consumption is expected to continue increasing at 8–9% per year.

Brazil is among the 10 largest economies in the world with a gross domestic product (GDP) of nearly \$1.6 trillion and *per capita* income of \$8,439. Inflation increased from 4.5% in 2007 to 5.9% in 2008. Economic growth in 2008, measured by the growth in GDP, was 5.1%, driven by a 5.8% agricultural growth rate. Although Brazil's GDP increased in 2008 by 5.1%, the rate of growth declined by 3.6% in the last quarter of the year, reflecting the impact of the world financial crisis, which affected mostly the industrial sector.

The Brazilian government currently is forecasting 1.2% GDP growth in 2009, but the Organisation for Economic Cooperation and Development recently forecast a contraction of 0.3%. The dynamics of Brazil's economy have shifted over the past few years from export-led to demand-led growth. Brazil has paid down its debt, lowered interest rates, and cut back spending. Brazil had a \$24.7 billion trade surplus in 2008, with total exports at \$198 billion and imports at \$173 billion. The average

CONTINUED ON NEXT PAGE

Real-Dollar exchange rate for the year was R\$1.83/dollar. However, because of the international credit crunch, the exchange rate began to increase in the last part of the year and currently is quoted at R\$2.32 per dollar.

## PRODUCTION

Brazilian soybean production is expected to reach 58 MMT in 2008/09, down 3% from the previous year's 60 MMT. Producers had harvested 54% of the soybeans by the end of March 2009. Harvest began in Mato Grosso, where nearly one-third of Brazilian soybeans are produced, and had reached 86% by the end of March. Paraná, which accounts for 17% of Brazilian production, had harvested 70% of its soybeans by the end of March. Harvest began recently in Rio Grande do Sul, which accounts for 14% of Brazilian soybean production; nearly 70% of the soybeans in that state are in the pod-fill stage.

The drought that hit the south of Brazil was the primary source of lower soybean yields in that region. However, because soybeans are planted later than corn in that region, the drought did not damage the soybeans as much as it did the corn.

All of the major soybean-producing states now enforce a *vazio sanitário* to control soybean rust—a 60- or 90-day period when it is forbidden to plant soybeans. Initially, incidents of soybean rust were down again this year, helped by the dry weather earlier in the season. However, it appears that this led producers to lower their guard. An increase in humidity in February and March caused reports of soybean rust to more than double, from 1,381 cases at the end of February to 2,810 cases by the beginning of April. This is the highest level of incidents recorded since Brazil began to keep track in 2004. The majority of this year's cases were reported in the state of Paraná. Grain development is far

enough advanced that minimal yield impact is expected.

The USDA anticipates that soybean area will increase marginally in 2009/10. No large increases in area are possible in the south, where area is relatively fixed, or in Mato Grosso, where environmental concerns have effectively halted any further expansion. The next possible area for expansion is in the relatively undeveloped MAPITO region (where the states of Maranhão, Piauí, and Tocantins meet). In the south, some producers whose corn crop was particularly hard hit by the drought will likely switch to soy, which has more financial liquidity in Brazil. In Mato Grosso, some area is expected to switch from cotton to soy to take advantage of the lower production costs. After several years of drawing down on the fertilizer residual in the soil, producers will need to greatly increase the amount of fertilizer utilized or face a reduction in yields. The USDA forecasts an average trend yield, resulting in 2009/10 production of 59.5 MMT.

## CONSUMPTION

According to the Brazilian Association of Vegetable Oil Industries (ABIOVE), Brazil's processing capacity continued to grow at 4% per year, but expansion in refining capacity slowed from 6% growth in 2007 to a mere 1% growth in 2008. Bottling capacity also contracted slightly, by 1% (see Table 1).

Soybeans remain the primary oilseed in Brazil by a large margin. There were some reports that high soybean prices during the last year led some Brazilians to begin using olive oil for more cooking uses than just seasoning. However, there are no signs of a significant change in soybean consumption patterns.

According to Brazil's National Animal Feed Industry Syndicate (Sindirações), corn accounts for more than half of animal feed,

while soybean meal is 18% of animal feed. Feed production grew approximately 9% between 2007 and 2008 and is expected to continue growing at the same pace in the near future.

Consumption of soy-based drinks, while still only 1% of Brazilian nonalcoholic drink consumption, is one of the fastest growing markets in the sector, with a 19% increase in volume between 2007 and 2008. In response, several beverage companies are reportedly investing millions of dollars in this market.

## TRADE

Soybean exports in Marketing Year (MY) 2007/08 (February 2008–January 2009) rebounded from the 2006/07 level of 23.8 MMT to 24.5 MMT. A 9% (851,000 MT) decrease in exports to the European Union (EU) was more than compensated by an 18% (1.8 MMT) increase in exports to China.

The USDA forecasts exports of 25 MMT for MY 2008/09 and 24 MMT for MY 2009/10. This is only a slight reduction from last year's exports, as a possible contraction in global demand due to the economic crisis may be partially offset by less competition due to a drought-induced reduction in Argentine soybean supplies.

## STOCKS

Brazil has practically no public stocks of soybeans (38 MT as of January 31, 2009). On-farm storage capacity continues to be extremely small. Most of the storage is provided by cooperatives/local associations, processors, or at the port.

## POLICY

In 2006, in reaction to pressure from the European food industry, major soybean traders including Cargill, Bunge, Archer Daniels Midland Co., Dreyfus, and the André Maggi Group declared a two-year moratorium on purchasing soybeans from any newly deforested areas in the Amazon. ABIOVE and the National Grain Exporters Association both signed the moratorium. In mid-June 2008, the moratorium was extended for another year. For the first time, the Brazilian Ministry of Environment was a signatory to the agreement.

**Table 1.** Brazilian processing, refining, and bottling capacity

Capacity (MT <sup>a</sup> /day)	2006	2007	2008
Processing capacity	143,504	149,504	155,449
Refining capacity	20,010	21,280	21,550
Bottling capacity	15,952	15,715	15,635

<sup>a</sup>MT: metric tons. Source: the Brazilian Association of Vegetable Oil Industries (ABIOVE).



## Acquisitions/mergers

**CPM**, a process design and equipment provider for the oilseed, animal feed, biofuel, and cereal industries, has acquired certain **Lauhoff Corp.** assets, including all intellectual properties for rotary pressure cookers, flakers, stem crushers, and ancillary equipment. These assets will be combined with CPM's Wolverine Proctor division. Lauhoff is based in Detroit, Michigan, USA. CPM's business units include Crown Iron Works, California Pellet Mill, Roskamp Champion, Beta Raven, Century Extrusion, Greenbank Technology, and Wolverine Proctor. CPM, which is based in Waterloo, Iowa, USA, has production facilities in the Americas, Europe, and Asia.

**Molinos Rio de La Plata**, a member of the Group Pérez Companc and Argentina's largest branded food company, has agreed to sell its Peruvian unit to **Archer Daniels Midland Co.**, along with the rights to its vegetable oil brand, Ideal. The transaction was reported by the *La Nación* newspaper to be worth \$4.5 million, and was pending clearance from Peruvian authorities.

## Commodities

### CACAO/CHOCOLATE

Swiss chocolate maker **Barry Callebaut** has forged a distribution deal with **Bunge Alimentos** that promises to extend the reach of Callebaut's artisanal chocolate products in Brazil, according to ConfectioneryNews.com. With sales of chocolate slowing in the United States and Europe, emerging economies such as Mexico, China, and Brazil account for about half of the global growth in sales, the site said.

■■■

**Mars, Inc.** (McLean, Virginia, USA) has promised that its entire cocoa supply will be certified as sustainably produced by 2020, through a multiyear, multicountry deal signed with the Rainforest Alliance (New York, USA). The announcement followed a similar promise by **Cadbury**

(London, UK), which said in March 2009 that it will source only fair-trade cocoa for its Dairy Milk chocolate bars by the end of the second quarter of 2009.

### CANOLA/RAPSEED OIL

Chinese scientists have bred 20 new rapeseed varieties with oil content of up to 60%, according to the Xinhua news service. The varieties have been planted on a trial basis in six Chinese localities including Tibet, Xinjiang, Qinghai, Gansu, Inner Mongolia, and Heilongjiang since last year, Fu Tingdong, a botanist from **Huazhong Agricultural University** in Wuhan, was quoted as saying. China imports about 60% of its cooking oil. Forty percent of domestic cooking oil comes from rapeseed, whereas the remaining 60% comes from sesame, soybean, and nuts, the report noted.

### FISH OIL/MEAL

**Cargill** has stopped work on its omega-3 ingredient sourced from fish oil less than two years after it debuted in May 2007. A Cargill spokesperson told FoodNavigator.com that the company is not pushing omega-3 products at the moment. "It is a good product, but it is still in the development stage and we are retrenching our efforts to focus on other aspects of our portfolio," the anonymous source said.

■■■

**Croda Europe Health Care** has signed a deal with **Speirs Nutritionals Ltd.** of New Zealand to distribute Croda's omega-3 emulsions to food makers in the United Kingdom, Europe, and North America. Speirs will also microencapsulate Croda's Incrome-ga-branded fish oil concentrates into omega-3 emulsions, according to NutraIngredients.com.



### OLIVE OIL

**Packaged Facts**, a market research firm based in Rockville, Maryland, USA, estimates that total US retail sales of oils and shortenings—which include cooking and salad oils, olive oil, microwave browning/pan sprays, and shortening—grew 16% to reach \$4.6 billion in 2008. And olive oil accounted for 37% of total dollar sales during the period, the firm noted in its report entitled *Market Trend: Olive Oil in the U.S., 3rd Edition*.

### PALM OIL

**Sindora Bhd's** shareholders have approved the exchange of the company's Ladang Sungai Simpang Kiri oil palm estate in Batu Pahat with Sime Darby Plantation Sdn Bhd's Ladang Sungai Tawing's estate in Kluang, both located in Johor, Malaysia. The transaction was reported by the *Business Times* newspaper of Malaysia.

■■■

The **Sabah Land Development Board (SLDB)** will set up a palm oil mill in Pulau Sebatik, Malaysia, if the agency successfully rehabilitates 810 hectares of abandoned land. SLDB General Manager Jhuvarri Majid said the state government-owned agency would be talking to private investors to set up the mill on a joint-venture basis, according to a report by the Malaysia General News newswire.

### SUNFLOWER

Production of sunflower oil in the **Ukraine** will reach 2.5 million metric tons (MMT) in Ukraine for the marketing year 2008/2009, according to *Esmerk* magazine. Of that, 1.9 MMT is expected to be exported.

## New ventures

**AgStrong Inc.'s** new oilseed processing facility in Bowersville, Georgia, USA, will source canola and sunflowerseed from 31 area farmers, reports [www.IndependentMail.com](http://www.IndependentMail.com). Expected to open in July 2009, the plant will press oil from the seeds, partially refine the oil prior to shipping, and use the leftover meal in animal feed. AgStrong is based in Winterville, Georgia.

■■■

CONTINUED ON PAGE 357

## Students turn corn, soy into new products

Three teams of Purdue University (West Lafayette, Indiana, USA) students that created new uses for corn and soybeans—melt-away cupcake liners, biodegradable cork, and toilet paper—took top honors in the 2009 Student Soybean and Corn Innovation Contests.

The competition, sponsored by the Indiana Soybean Alliance and the Indiana Corn Marketing Council, focuses on teaching students how to become innovative entrepreneurs. The awards were presented in March.

“These contests are about more than just creating new products,” said Bernie Tao, Indiana Soybean Alliance professor of soybean utilization at Purdue and an AOCs member. “These contests help the students take what they have learned in class and apply that knowledge to solve real-world issues.”

Purdue’s TerraMat (see photo) and Melt-A-Way Cupcake Liners teams tied for top honors in the soybean portion of the competition, earning \$17,500 each.

TerraMat, a cork product that can be made of both soybeans and corn, was created by Jacob Smoker and Mohamad Abiad.

“We spent hours on the phone and in the lab, on conference calls and in meetings, trying to come up with an idea that would be new and innovative,” Smoker said. “One day while we were brainstorming in the lab, Mohamad noticed a synthetic cork board and suggested we try a natural, biodegradable cork product. We researched it and found that there were no corn- or soybean-based cork products on the market.”

With that, TerraMat was in the works. The product can be used in corkboards or floor mats. And, according to Smoker, it is not bad to munch on either.

“One day, Jake started eating the product,” Abiad said. “After a couple of bites he looked at me and said, ‘Hey, man, this is really sweet!’”

Although TerraMat isn’t actually made to snack on, Melt-A-Way Cupcake Liners are designed to become part of the cupcake during the baking process. This eliminates the hassle of removing a paper liner and also reduces paper waste.



*TerraMat, a soy-based cork product created by Purdue University students Jacob Smoker, left, and Mohamad Abiad, tied for the top prize in the 2009 Indiana Student Soybean Innovation competition. Courtesy of Purdue Agricultural Communications. Photo by Tom Campbell.*

“Our team was thinking about creating waxed paper from soybeans or corn, but we decided we wanted a more novel product,” said Erin Rosswurm, one of the product’s inventors. “I was thinking one night about how waxed paper could be improved and came up with the idea for a cupcake liner. Our entire team has cooking and food science experience, so the project used a combination of our interests and backgrounds.”

Rosswurm’s teammates were Victoria Horton, Marci Colglazier, and Anna Verseman.

“One of my favorite memories from the contest was our first trial run, when the cupcakes came out of the oven with no major problems,” Rosswurm said. “I was so scared that we would have smoking cupcakes or some other disaster and that we would have to start the process from scratch.”

In the corn-only portion of the contest, members of team Nature’s Silk came up with a process for biodegradable toilet paper. The product earned a cash prize of \$10,000.

“We were sold on the idea of Nature’s Silk from the beginning,” said Jessamine Osborne, a double major in cell molecular development and genetics. “The idea is simple. We could not figure out why this product wasn’t already on the market.”

Osborne’s teammates included Janie Stine and David Jaroch.

This year’s competition drew a record 33 students on 12 teams—nine of which competed in both corn and soybean categories. Other products in this year’s competition included a decomposable flowerpot, snow removal and de-icing solution, car wax, paint balls, disposable cups, biodegradable cigarette filters, hydroplaning solution, biodegradable shotgun cartridge casings, and a biodegradable garden container.

## Action on industrial hemp in the United States

Cultivation of industrial hemp in the United States may become legal if a bill introduced in Congress is passed by both houses. The oil and fiber of industrial hemp—the nonpsychoactive variety of the *Cannabis sativa* plant—are legal to import but not to grow and are used by a number of manufacturers in both food and personal care products.

The legislation, if passed by the House and Senate, would amend the Controlled Substances Act and undo a section of the 1937 Marihuana Tax Act, which dismantled the US industrial hemp industry by consolidating the plant with its cousin, marijuana. Cultivation of industrial hemp currently is legal in more than 30 nations, including



Canada, China, Russia, Hungary, Germany, the Netherlands, France, Spain, England, Poland, and many other Eastern European countries.

To view the full text of the bill, its status, and a list of sponsors, visit [www.govtrack.us/congress/bill.xpd?bill=h111-1866](http://www.govtrack.us/congress/bill.xpd?bill=h111-1866).

## Volunteer consultants sought

A volunteer oilseed processing consultant is being sought by the Farmer-to-Farmer program of the Citizens Network for Foreign Affairs (CNFA; Washington, DC, USA).

The program, which is funded by the US Agency for International Development, sends US citizens with agricultural and/or food expertise on two- to three-week volunteer assignments to share their skills with host organizations in developing countries.

The current volunteer opening involves helping a small organization—Mitunguu Millers—in Kenya, Africa, with its cold-pressed sunflower oil extraction efficiency. Although the work itself is done on a volunteer basis, CNFA will cover all expenses associated with the assignment using government funding.

For more information about volunteering for this particular assignment or for future openings, contact Sapna Shah of CNFA at [sdshah@cnfa.org](mailto:sdshah@cnfa.org).

## FEDIOL announces new leader

Nathalie Lecocq has succeeded Pascal Cogels as director general of FEDIOL, the European Oil and Proteinmeal Industry. Cogels retired after 19 years as head of the association.

Lecocq, who took over as of April 1, is a French national. She holds a degree in agro-economics from the University of Bonn, Germany. She has 20 years of experience in the agro-food sector in Europe and in her latest position was director of economic affairs at the Confederation of the Food and Drink Industry of the EU.

The FEDIOL staff is now made up of the following managers: Claire-Lise Bechert—deputy director general, also is in charge of Food Safety & Consumer Affairs; Coen Blomsma—Feed Safety &

**Verenium Corp.** (Cambridge, Massachusetts, USA), a producer of specialty enzymes and cellulosic ethanol, has signed an agreement with **Alfa Laval** (Lunda, Sweden), a provider of heat transfer, separation, and fluid-handling technologies, to jointly market enzymatic degumming of vegetable oils using Verenium's Purifine PLC enzyme and Alfa Laval's engineering services and equipment.

■ ■ ■

**Ragasa**, one of Mexico's largest providers of raw and refined oil products, plans to introduce a vegetable oil with added docosahexaenoic (DHA) omega-3 fatty acid in 2009. The DHA will be sourced from **Martek Biosciences Corp.** of Columbia, Maryland, USA. Ragasa is based in Monterrey.

■ ■ ■

**Marubeni Corp.** of Tokyo will collaborate with **Sinograin Oil & Fats Corp.**, a subsidiary of Sinograin (China Grain Reserves Corp.), China's largest grains reserve operations company. The agreement, announced in a joint news release, includes plans for Marubeni to import 4 MMT of soybeans for crushing into China (about 10% of China's total annual import).

## R&D

Electrospinning of **zein prolamine fibers** can nano-encapsulate  $\beta$ -carotene and protect it against oxidation, according to researchers from the Novel Materials and Nanotechnology Lab at the Institute of Agrochemistry and Food Technology in Valencia, Spain. Zein is a protein found in corn (maize). Electrospinning uses an electrical charge to draw very fine (typically on the micro- or nano-scale) fibers from a liquid. The work appeared in *Food Hydrocolloids* (23:1427–1432, 2009).

■ ■ ■

A combination of sesame oil, hydrocolloids, and emulsifiers could replace fat in cakes, according to work by researchers at India's **Central Food Technological Research Institute** in Mysore. The work appeared in *Food Hydrocolloids* (doi:10.1016/j.foodhyd.2009.02.008) and was led by D. Indrani. The scientists report that replacing 50% of the fat with sesame oil and hydroxypropylmethylcellulose and sodium stearoyl-2-lactylate could lead to low-fat cakes with good textural properties. ■

Environmental Affairs; Pierre Tardieu—Trade & Economics; Sonia Goetz—Scientific & Regulatory Affairs; Geneviève

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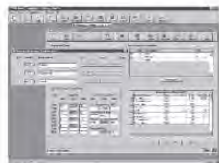
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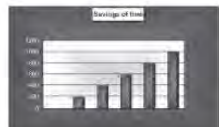
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## Briefs

A new website, [www.jatropha.com](http://www.jatropha.com), has been started as an Internet-based global meeting point for people interested in jatropha. It intends to serve landholders who are growing or would like to grow jatropha. Jatropha.com's mission is to actively involve all jatropha stakeholders (seeds producers, processing plants, energy and biodiesel producers, final consumers, as well as research centers and institutions) in the creation of a sustainable biofuels market. Another useful site having information regarding jatropha and its growth is [www.jatropha.de](http://www.jatropha.de).



In late March ExxonMobil became the first company to sell biodiesel in New Zealand. It introduced a B5 blend (5% biodiesel, 95% petrodiesel) made from tallow in a marketing trial in the Bay of Plenty. The company has been criticized for lagging behind in the development of bioenergy projects and investments, according to Biofuels-Digest.com. Gull Petroleum (Auckland, New Zealand) introduced E10 fuel (10% ethanol, 90% gasoline) in the country in 2007.



A group of farmers in Hampton and Easton, New York (USA), planted pennycress (*Thlaspi arvense*) in September 2008 with the intention of harvesting the seeds in May–June 2009 (*inform* 19:673, 2008). In turn, plans for the harvest included replanting additional acres with pennycress, with the seeds (oil content 30% or more) from that crop ultimately destined to be processed into biodiesel. In late April, however, the consensus seemed to be that a crop failure had occurred. According to the *Albany Times Union*, Joe Dickson, senior vice president of business development for Innovation Fuels Inc. (Albany, New York), which funded the experiment, said, "It's a trial and error thing." ■

# Biofuels News



## BIODIESEL

### Canadian Bioenergy, ADM may make biodiesel from canola

A joint study sponsored by Canadian Bioenergy (Vancouver, British Columbia) and Archer Daniels Midland Co. (ADM; Decatur, Illinois, USA) is evaluating the feasibility of constructing Canada's largest canola biodiesel plant. If the project proceeds, construction will take place at ADM's canola-crushing plant in Lloydminster, Alberta. The plant will be scaled to produce 265 million liters per year. Annually, the plant would need 240,000 metric tons (MT) of canola oil, crushed from about 600,000 MT of seed. According to Reuters UK, Canada produced 12.6 million MT of canola seed in 2008.

The Lloydminster plant would be integrated into the ADM crushing facility, but

it would be jointly owned and operated by ADM and Canadian Bioenergy.

According to the *Canadian Press*, Doug Hooper, chief executive of Canadian Bioenergy, indicated overall costs have not yet been determined, but "[I]t's quite a bit more capital- and operating cost-efficient to integrate a plant within a canola crushing complex."

If the project proceeds, construction could start in the fourth quarter of 2009 and finish by the first quarter of 2011, according to Reuters.

Canadian Bioenergy's plans to construct a 225 million liters per year canola biodiesel plant near Edmonton, Alberta, next to Bunge Canada's oilseed crushing plant, are on hold pending the outcome of the Canadian Bioenergy/ADM study.

### Biodiesel in Germany, Spain

The German Parliament has approved blending of up to 7% biodiesel into petroleum diesel from February 2009 onward. With this new regulation, total biodiesel

CONTINUED ON NEXT PAGE

sales are predicted to rise from the present 1.5 million metric tons per year (MMT/yr) to 2.0 MMT/yr. This regulation was passed in response to the new directive from the European Union (EU), which is asking for a minimum market share of 10% renewable energy in the traffic segment by 2020.

If the 7% blend is implemented in the rest of the EU, there should be additional opportunities for Germany to export its current production overcapacity for biodiesel. At present, Germany's biodiesel industry is working at less than 60% capacity because of higher taxes on green fuels and reduced blending levels with fossil fuels, according to an April 23 statement to Reuters by Johannes Daum, political director of the German biofuels industry association VDB. Germany had about 1,900 petrol stations that sold biodiesel in early 2008, but Daum said this number has fallen now to about 250.

Spain, too, is having problems with increasing its biodiesel production. As of January 1, the country had a mandatory target that 3.4% of automotive fuel used in 2009 be derived from biofuel, rising to 5.83% in 2010. But at present, Reuters reports that Spain's biodiesel plants are running at just 9% of capacity. Producers are hoping that duties imposed recently by the EU on US imports of biodiesel will trigger increased production.

## Genetic resource center for jatropha

SG Biofuels, a sustainable plant oil company based in San Diego, California, USA, opened its Jatropha Genetic Resource Center (GRC) at the end of April. Its purpose is to accelerate profitable, large-scale production of jatropha as a low-cost, sustainable source of feedstock for biofuel.

*Jatropha curcas* is a shrub native to Central American that grows well on marginal land (*inform* 19:834–836, 2008). Its seeds, which are inedible, contain high amounts of oil that can be used for biodiesel and as a feedstock substitute for the petrochemical and jet fuel industries.

With research sites in San Diego and several Latin American countries, SG Biofuels and its GRC claim to possess the largest, most genetically diverse library of jatropha genetic material in the world. The GRC will aid the company's efforts



Mike Yoder, Doug Morrow, Trevor Glick, Bernard Tao, John Whittington, and J. Andres Soria stand by a pickup truck running on B100 "Permaflo Biodiesel." The truck was filled by an unheated tote outside in 20°F temperatures. Photo courtesy of Indiana Soybean Alliance.

## Biodiesel tested in the Arctic

The Indiana Soybean Alliance (Indianapolis, USA) sponsored a trip to Alaska in early March to demonstrate the viability of "Permaflo Biodiesel" produced by Integrity Biofuels (Morristown, Indiana). AOCS member Bernard Y. Tao, professor of agricultural and biological engineering at Purdue University (West Lafayette, Indiana), who helped develop a method to make biodiesel flow at low temperatures, was along on the trip to monitor the demonstration of his invention.

Several vehicles and a generator, all fueled by biodiesel, made the journey to the Arctic Circle. Temperatures fell as low as -23°F (-31°C) over the course of the trip, which covered 1,401 miles (2,255 kilometers).

J. Andres Soria, a member of the convoy and a biofuel developer with the University of Alaska, told the *Anchorage Daily News*, "Both the generator and the vehicles didn't sputter once" while burning 100% biodiesel.

Tao's process uses urea clathrates to separate saturated oil molecules, which gel at relatively high temperatures, from unsaturated ones, which gel at lower temperatures. Varying the amount of urea used produces fuel with varying saturated/unsaturated ratios, allowing a biodiesel producer to tailor the biodiesel to the temperature, down to about -60°F (-51°C).

The urea can be removed and reused, and the refining process costs about \$0.05 per gallon, according to Tao. (The Indiana Soybean Alliance and Purdue University share the rights to the innovation.)

Since soybeans do not grow in Alaska, Soria suggested that Alaskans could create a biofuel cooperative based on restaurants saving their used cooking oil for conversion to biodiesel. Another possibility is to grow canola for its oil in southern Alaska; the seeds would not have enough growing time to mature to the point where people would want to eat them, but the seeds would develop enough to contain a good deal of oil.



to implement genetic improvements to enhance yield, improve agronomic practices, and broaden the effective growing range of this subtropical crop.

The company proposes that oil yields of 200–300 gallons (800–1,000 liters) of extractable oil per acre annually are realistic today, and Kirk Haney, president and chief executive officer for SG Biofuels, said in a company press release, “[W]e are confident we can double the yield of jatropha within the next few years.”

## GENERAL

### California approves world's first Low-Carbon Fuel Standard

On April 24, the California Air Resources Board adopted the world's first Low-Carbon Fuel Standard. Once implemented, it should dramatically reduce the environmental impact of transportation on the state. The influence could also spread to the entire United States, since California is a national leader in environmental legislation.

Starting in 2011, the standard steadily lowers the allowable “carbon intensity” of fuels, i.e., the amount of greenhouse gases released for every unit of energy produced. By 2020, fuel refiners and distributors within the state will have to decrease the carbon intensity of their fuels by 10%. Increased use of alternative fuels is predicted to protect against price spikes.

Controversy has surrounded this proposal. Ethanol producers who make their fuel from corn say they are unfairly being blamed for deforestation in the developing world. Scientists argue about the validity of the standard's methodology. Economists worry about its effects on efforts to develop further sources of petroleum-based fuels, and oil companies say details are lacking.

### Canada fuel standards to match US standards

Canada's Environment Minister Jim Prentice announced in April that 2011 model



cars and light trucks manufactured in Canada will be required to meet tailpipe carbon emission standards equal to the US fuel-efficiency standards that were announced in late March. The US goal is to achieve 35 miles per gallon (6.7 liters per 100 kilometers) by 2020.

At present, the Canadian standard is 8.6 liters/100 kilometers, but according to the *Edmonton Journal* (Alberta, Canada) the actual performance of cars on the road in Canada is 7.1 liters per 100 kilometers.

In an *Edmonton Journal* interview, Canadian automaker representative Mark Nantais said, “If we don't do this, if we don't harmonize on a North American basis, it will mean more cost to the consumer.” Further, “If we were to adopt something unique in Canada, we lose economies of scale.”

### Brazil and US to collaborate on biofuel research

Under the auspices of the US Department of State, through the Fulbright Commission in Brazil, a network of biofuels-related faculties and researchers from a range of institutions in Brazil and in the United States is being established to enhance information exchange and facilitate research collaboration and partnerships.

The Brazil-US Higher Education Council is expected to provide information and access to funding opportunities, promote awareness of research projects in both countries, develop and advance scientific exchange, and improve communication among researchers. At the Network website ([www.brazil-usa-henetwork.org](http://www.brazil-usa-henetwork.org)) there is information on biofuels and funding as well as a virtual library; a database of information concerning Network members; and other aspects that will develop as user input is received.

The Council also plans to initiate short courses in biofuels technologies and meetings of Network members. Further information is also available from Thais Rodrigues Coser at [thais@fulbright.org.br](mailto:thais@fulbright.org.br).

## ETHANOL

### Power equipment and ethanol

Kris Kiser, executive vice president of the Outdoor Power Equipment Institute (OPEI; Alexandria, Virginia, USA), spoke in March to the Senate Clean Air and Nuclear Safety subcommittee, which was reviewing the oversight of biofuels by the US Environmental Protection Agency (EPA). Kiser expressed concerns that a higher ethanol mix in gasoline could destroy engines, as well as void warranties, on vehicles, power tools, and boat motors designed for 10% ethanol blend.

In a scenario presented in the April 1 *Chicago Tribune*, OPEI hypothesized a chainsaw, running on idle, that spontaneously starts running too rapidly. OPEI warns this could happen if a fuel having an increased oxygen content (e.g., an increased ethanol content) was used to power the engine, causing it to idle at a higher speed, as if the clutch were engaged. This could be a serious safety issue.

### Water discharge reduced 23%: POET

One aspect of the production of bioethanol often criticized is the amount of water needed to process it. POET Biorefining (Sioux Falls, South Dakota, USA) announced that its Bingham Lake (Minnesota) bioethanol plant has decreased its water usage by 23%. The plant, which makes 35 million gallons (130 million liters) of ethanol per year on average, formerly used 3.42 gallons (12.9 liters) of water to produce 1.0 gallon (3.8 liters) of ethanol. With zero-liquid discharge, that number now has been cut to 2.64 gallons of water per gallon of ethanol.

“Zero-liquid discharge” means that no water is discharged to the environment. Water leaving the plant is limited to steam and to the water content present in POET by-products, such as Dakota Gold dried distillers' grain.

## ALGAE

### OriginOil announces process to extract oil from algae

In mid-April, Los Angeles-based OriginOil announced a single-step process to extract oil from algae. Oil, water, and biomass separate by gravity. No chemicals or heavy machinery is used, and no initial dewatering is required.

Cell walls are broken down through the company's Quantum Fracturing™ process, in which algae in water, in the presence of special catalysts, are ultrasonicated to crack the cell membrane and release the oil contained therein. Oil then rises to the top, from whence it can be skimmed and then refined. Fractured cells settle to the bottom, where they can be collected for further processing as fuel or other products.

A company press release said that, in addition to integrating this process into its own production system, OriginOil plans to commercialize the patent-pending process for use by others in the fast-growing algae industry.

### Algal oil extraction process leaves cells intact

Researchers at the US Department of Energy's Ames Laboratory, which is operated by Iowa State University (Ames, Iowa, USA), have developed groundbreaking "nanofarming" technology that safely harvests oil from algae without damaging the cells. The technology is being commercialized through a cooperative research and

development agreement between the Ames Laboratory and Catilin, Inc. (Ames, Iowa), a nanotechnology-based company that specializes in biofuel production.

The so-called nanofarming technology uses sponge-like mesoporous nanoparticles to extract oil from the algae. The process does not harm the algae, unlike other methods being developed elsewhere. Thus, production costs are lowered, and the oil-generation cycle is shortened.

Oil, once extracted, is subjected to a solid catalyst from Catilin that easily converts the oils to ASTM- and EN-certifiable biodiesel.

Victor Lin and Marek Pruski are co-investigators on the project. Phases one and two of the project will cover the culturing and selection of microalgae, as well as the development of the specific nanoparticle-based extraction and catalyst technologies for the removal of algal oil and production of biodiesel, respectively. Phase three will focus on scale-up of the catalyst and pilot plant testing of conversion to biodiesel.

### PetroAlgae to enter Asian markets

GTB Power Enterprise of Los Angeles, California, USA, a limited liability company, entered into a Master License Agreement with PetroAlgae (Melbourne, Florida, USA) on March 5 to use PetroAlgae's technology to construct and operate up to 10 facilities for the growth and harvesting of algae for the production of oil and biomass in the People's Republic of China, in Taiwan, and in Yonaguni, the western and southern-most island of Japan.

Each facility will consist of 5,000 hectares of land, and each will be constructed in increments of 500 hectares. The Licensee will plan, construct, and operate the facilities so as to maximize their revenues. In turn, the Licensee will pay a fixed licensing fee for each facility, contingent on a

number of factors, including the ability of each facility to meet performance targets, which have yet to be determined.

The license is for 20 years, and the Licensee has the option to extend for two additional 20-year periods.

PetroAlgae had said in February that it would sign its first major licensing agreement by the end of the first quarter.

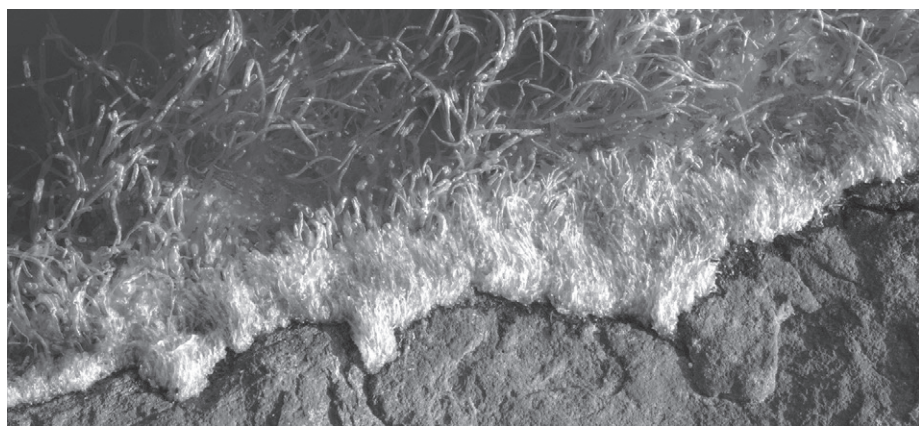
## RENEWABLE DIESEL

### Amyris renewable diesel registered by US EPA

The US EPA officially registered the renewable diesel fuel made by Amyris Biotechnologies (Emeryville, California, USA) in April, making this the first time a hydrocarbon-based fuel made from plant-derived resources has been registered for commercial sale. Advantages of Amyris renewable diesel include the following:

- Amyris renewable diesel is a hydrocarbon, the same component found in petroleum fuels, enabling it to blend with petroleum diesel without causing performance issues.
- It works well at extremely low temperatures without having to alter engines; it can easily be distributed with the existing fuels infrastructure.
- Blended with petroleum diesel, it fully complies with ASTM D 975 specifications for petroleum diesel fuels.
- It contains zero sulfur and virtually no harmful aromatics. When blended with petroleum diesel it produces significantly less particulate matter, NO<sub>x</sub>, hydrocarbon, and carbon monoxide emissions than petroleum fuels.

Amyris renewable diesel is made by means of synthetic biology. Company scientists have altered the metabolic pathways of microorganisms, such as yeasts, so that they transform sugars into a wide variety of compounds important for energy, pharmaceutical, and chemical applications. The website for the company says it expects to have a renewable diesel commercially available by 2010, and a renewable jet fuel as early as 2012. ■





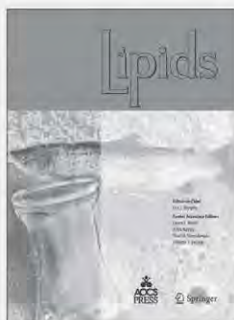
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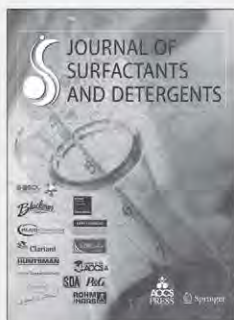
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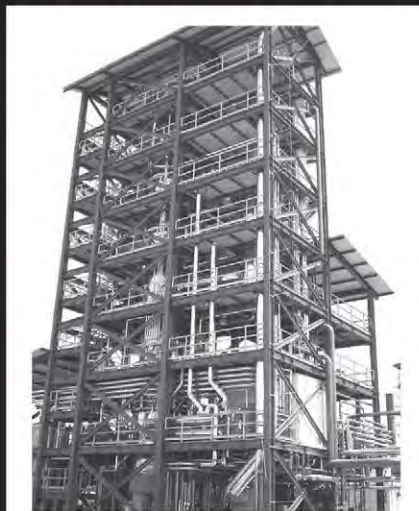
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A new website promises to allow consumers to search, compare, and contrast thousands of manufactured foods by specific ingredients, allergens, and additives. The free site is available at [www.FoodEssentials.com](http://www.FoodEssentials.com).

■ ■ ■

Martek Biosciences Inc., the company that pioneered algal and fungal production of omega-3 fatty acids, was inducted into the Space Technology Hall of Fame in April 2009. The company, whose life'sDHA™ ingredient is used in about 95% of infant formula products sold in the United States, first explored the use of microalgae for nutrition as part of a NASA research project. Martek is based in Columbia, Maryland, USA.

■ ■ ■

A team led by Jean-Michel Weber, of the University of Ottawa hypothesize how the sandpiper is able to make a 3000-kilometer flight from the birds' summer home in the Canadian Arctic to the South American coast—a flight that includes three days of nonstop flying over open water. The short answer: because of a frantic two-week feeding period during which the birds gorge on mud shrimp. The shrimp are loaded with omega-3 fatty acids, which the scientists say makes sandpipers' muscles use oxygen more efficiently (by as much as 90%), enhancing the birds' endurance.

The study appeared in *The Journal of Experimental Biology* (212:1106–1114, 2009).

■ ■ ■

Blood levels of the soy isoflavone genistein were higher in human subjects after they consumed soy food with an isoflavone content of 96 mg than for isoflavone-rich supplements, according to a study led by Christopher Gardner of Stanford University in Palo Alto, California, USA. The study appeared in the *Journal of Nutritional Biochemistry* (20:227–234, 2009).

“The findings from this investigation suggest that bioavailability may be higher from food sources of isoflavones than from tablets, and that spreading the intake out in multiple doses over the course of the day will lead to more constant steady-state plasma concentrations,” Gardner and colleagues write. ■

# Health & Nutrition



## ISSFAL issues statement on n-3 conversion

α-Linolenic acid (ALA) does not convert to docosahexaenoic acid (DHA) in the human body at levels that provide any physiological benefit, according to a statement developed and edited based on input from members of the International Society for the Study of Fatty Acids and Lipids (ISSFAL).

In summary, ISSFAL stated that:

- ALA conversion to EPA (eicosa-pentaenoic acid), DPA (docosapentaenoic acid), and DHA in tracer studies has been observed in nearly all humans studied from birth through late middle age and in both males and females.
- The majority of evidence from isotopic tracer studies shows that the conversion of ALA to DHA is on the order of 1% in infants and is considerably lower in adults. This is consistent with measurements of whole-body ALA oxidation, which is the predominant fate of ALA in both rodents and humans. These “conversion rates” must be viewed as markers of flux through this metabolic pathway but must not be assumed to represent a net change in mass.
- Very few studies in adults show that bloodstream or breast milk DHA

concentrations increase following several weeks of increased dietary ALA supply, whereas most studies do not. ALA appears to contribute little to circulating DHA when added to a diet that already contains some ALA and high levels of linoleic acid (LA).

- Supplementation of the diet with high levels of ALA leads to small but significant increases in EPA and DPA although supplementation with pre-formed EPA is approximately 15 times more efficacious in this regard.
- Dietary DHA increases blood and tissue DHA beyond that achievable with consumption of usual intakes of any precursor omega-3 polyunsaturated fatty acids, against a background of Western diets providing ample omega-6 fatty acids.
- For a given dietary concentration of ALA, the conversion of ALA to long-chain polyunsaturated fatty acids (LC-PUFA) is decreased by high dietary ratios of LA/ALA. Moreover, omega-6 fatty acid intake influences tissue concentrations of the omega-3 LC-PUFA. Present evidence indicates that omega-3 LC-PUFA status can be improved by increasing their intake or by decreasing LA intake, and a combination of the two is likely to be most effective.

The statement, which appeared in *Prostaglandins, Leukotrienes and Essential Fatty Acids* (80:85–91, 2009), was co-authored by J. Thomas Brenna of Cornell

University (Ithaca, New York, USA), Norman Salem Jr. of Martek Biosciences Inc. (Columbia, Maryland, USA), Andrew J. Sinclair of Deakin University (Burwood, Victoria, Australia), and Stephen C.unnane of the Université de Sherbrooke (Québec, Canada). It can be found at [www.issfal.org.uk/pufa-recommendations.html](http://www.issfal.org.uk/pufa-recommendations.html).

## Disappearing antioxidants

Olive oil that has been sitting on the shelf for six months can lose up to 40% of its antioxidants, according to a study in the *Journal of Food Science* (74:C177–C183, 2009).

Researchers, led by Antonella Baiano of the University of Foggia in Italy, analyzed several varieties of extra-virgin olive oil produced from groves in the Italian countryside at production and during storage. They found that after three months of storage, the antioxidant activity in the oils remained unchanged, but antioxidants decreased by about 40% for almost all of the oils after six months.

“The protective role of virgin olive oil is the result of its

specific composition including phenolic compounds known to act as antioxidants,” says Baiano. She recommends consumers store extra-virgin olive oil in small glass bottles (one liter maximum because the oxygen contained in the headspace determines the amount of oxidation), in a dark location, at a temperature lower than 68–77°F (20–25°C).

## Why olive oil is healthful

Scientists may have pinned down the constituent of olive oil that gives the greatest protection from heart attack and stroke. In a study of the major antioxidants in olive oil, Portuguese researchers showed that 3,4-dihydroxyphenyl ethanol-elenolic acid dialdehyde (DHPEA-EDA) protects red blood cells from damage more than any other part of olive oil.

“These findings provide the scientific basis for the clear health benefits that have been seen in people who have olive oil in their diet,” says lead researcher Fátima Paiva-Martins of the University of Porto.

In the study, published in *Molecular Nutrition & Food Research* (doi: 10.1002/mnfr.200800276), Paiva-Martins and colleagues compared the effects of four related polyphenolic compounds on red blood cells subjected to oxidative stress by a known free radical-generating chemical.

DHPEA-EDA was the most effective and protected red blood cells even at low concentrations. The researchers say the study provides the first evidence that this compound is the major source of the health benefit associated with virgin olive oils, which contain increased levels of DHPEA-EDA compared with other oils. In virgin olive oils, DHPEA-EDA may make up as much as half the total antioxidant component of the oil.

## Omega-3s and prostate cancer

Omega-3 fatty acids appear protective against advanced prostate cancer, and this effect may be modified by a genetic variant in the cyclooxygenase-2 (COX-2) gene, according to a report in *Clinical Cancer Research* (doi 10.1158/1078-0432.CCR-08-2503).

“Previous research has shown protection against prostate cancer, but this is one of the first studies to show protection against advanced prostate cancer and interaction with COX-2,” says John S. Witte, professor of epidemiology and biostatistics at the University of California–San Francisco.

For the current study, researchers performed a case-control analysis of 466 men diagnosed with aggressive prostate cancer and 478 healthy men. Diet was assessed by a food frequency questionnaire and researchers genotyped nine COX-2 single nucleotide polymorphisms.

Researchers divided the subjects into four groups based on quartiles of omega-3 fatty acid intake. Men who consumed the highest amount of long-chain omega-3 fatty acids had a 63% reduced risk of aggressive prostate cancer compared with men with the lowest amount of long-chain omega-3 fatty acids.

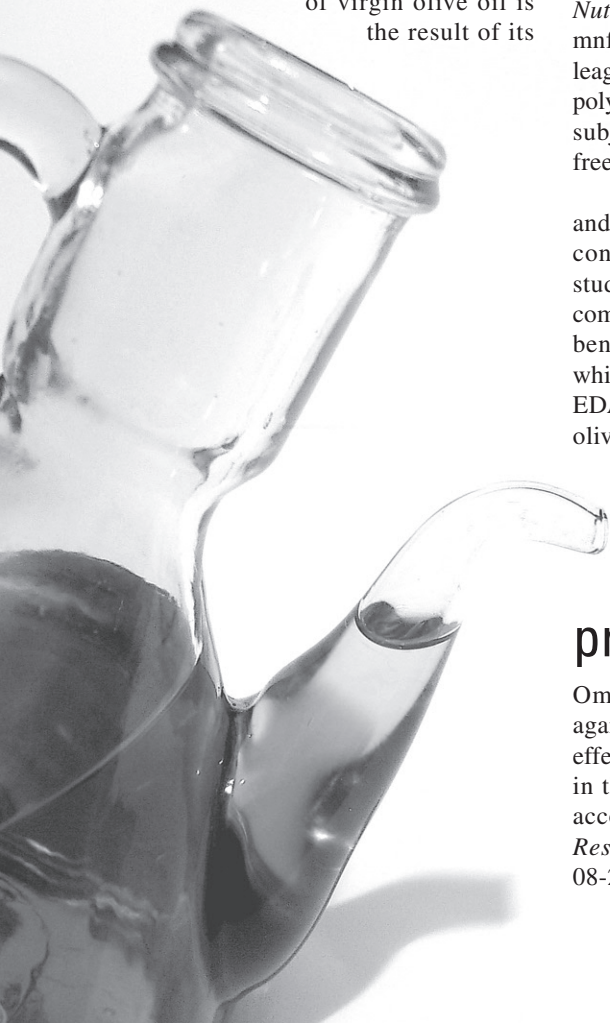
The researchers then assessed the effect of omega-3 fatty acid among men with the variant rs4647310 in COX-2, a gene known to promote inflammation. Men with low long-chain omega-3 fatty acid intake and this variant had a more than five-times increased risk of advanced prostate cancer. But men with high intake of omega-3 fatty acids had a substantially reduced risk, even if they carried the COX-2 variant.

“The COX-2 increased risk of disease was essentially reversed by increasing omega-3 fatty acid intake by a half a gram per day,” said Witte. “If you want to think of the overall inverse association in terms of fish, where omega-3 fatty acids are commonly derived, the strongest effect was seen from eating dark fish such as salmon one or more times per week,” he concluded.

## Standards developed for vitamin D

An advance in developing an accurate, reliable set of standards for measuring vitamin D levels in blood was presented at the American Chemical Society’s 237th National Meeting in Salt Lake City in late March 2009.

Despite concerns about adequate vitamin D intake, there is no standard laboratory test for measuring vitamin D levels in humans, and no universal agreement on





what are considered “normal” or “optimal” vitamin D levels. To understand vitamin D’s role in health and disease, and use that knowledge in everyday medicine, laboratories need better measurement standards, the researchers said.

“No one really knows what methods or assays are correct at this point,” said Mary Bedner, an analytical chemist with the National Institute of Standards and Technology (NIST) in Gaithersburg, Maryland, USA. “Right now, you can send a blood sample to two different labs and get completely different results for vitamin D.”

About three years ago, NIST, the federal government agency that sets measurement standards, began efforts to develop a standard for measuring vitamin D in collaboration with the National Institutes of Health’s (NIH’s) Office of Dietary Supplements. Later this year, after much consultation with experts and extensive laboratory testing, NIST scientists plan to unveil their standard to the public in a development that promises to lead to a better understanding of vitamin D in health and disease.

The most commonly used indicator of a person’s vitamin D status is the measurement of 25-hydroxyvitamin D in the blood. But several different forms of this vitamin exist in the blood—including 25-hydroxyvitamin D2 and 25-hydroxyvitamin D3—that are of clinical significance and would be overlooked by scientists focusing on total 25-hydroxyvitamin D alone.

To account for these other forms of vitamin D, NIST developed Standard Reference Material 972 (SRM 972). The material is composed of four different pools of human blood serum obtained from a wide crosssection of blood donors. Each of the four pools contains different amounts of 25-hydroxyvitamin D2 and D3 to represent vitamin D profiles normally seen in a clinical setting. All were carefully measured using a combination of liquid chromatography and mass spectroscopy.

One pool represents “normal” serum, which contains mostly 25-hydroxyvitamin D3. The second pool, which represents vitamin D-deficient individuals, contains about half as much 25-hydroxyvitamin D3 as the “normal” pool. The third represents the blood profile of someone taking vitamin D supplements and contains elevated levels of 25-hydroxyvitamin D2. Finally, the fourth pool contains high levels of 3-epi-25-hydroxyvitamin D3, or the “epi” form

of vitamin D, which is typically found in the blood of small children.

By using these four blood samples as reference points, clinical laboratories can calibrate their instruments and measurement techniques to ensure more accurate and reliable vitamin D measurements for blood samples so doctors can make the right treatment decisions. As a result, testing based on this standard can more reliably tell patients whether they are getting enough vitamin D and provide information about what forms of vitamin D they need to take to stay healthy, the researchers say.

“Accuracy is key,” Bedner says. “We need to provide a reference material that other people can trust.”

The researchers plan to make their reference standard commercially available within the next year. NIST and NIH funded the research.

## ADA takes a position on health claims

The American Dietetic Association (ADA; Chicago, Illinois, USA) released an updated position on functional foods on April 1, 2009. The statement says that fortified, enriched, or enhanced foods can benefit a person’s health when consumed as part of a varied diet; encourages further research; and urges continued efforts to educate the public on such foods.

ADA’s position, published in the *Journal of the American Dietetic Association* (109:735–746, 2009), represents the Association’s official stance on functional foods: “All foods are functional at some physiological level, but it is the position of the American Dietetic Association that functional foods that include whole foods and fortified, enriched, or enhanced foods have a potentially beneficial effect on health when consumed as part of a varied diet on a regular basis, at effective levels. ADA supports research to further define the health benefits and risks of individual functional foods and their physiologically active components. Health claims on food products, including functional foods, should be based on the significant scientific agreement standard of evidence and ADA supports label claims based on such strong scientific substantiation. Food and nutrition

professionals will continue to work with the food industry, allied health professionals, the government, the scientific community and the media to ensure that the public has accurate information regarding functional foods and thus should continue to educate themselves on this emerging area of food and nutrition science.”

The paper includes definitions of the terms as used in different countries and notes that “functional foods” is a marketing and not a legal term. The ADA defines functional foods as those that “move beyond necessity to provide additional health benefits that may reduce disease risk and/or promote optimal health. Functional foods include conventional foods, modified foods (fortified, enriched, or enhanced), medical foods, and foods for special dietary uses.”

Examples of conventional food with functional properties include broccoli, nuts, and tomatoes. Modified foods include calcium-enhanced orange juice, folate-enriched breads, and foods formulated with bioactive ingredients such as fish oils, plant sterol esters, or lutein. Medical foods include PKU formulas free of phenylalanine. Foods for special dietary uses include gluten-free and lactose-free foods. ■

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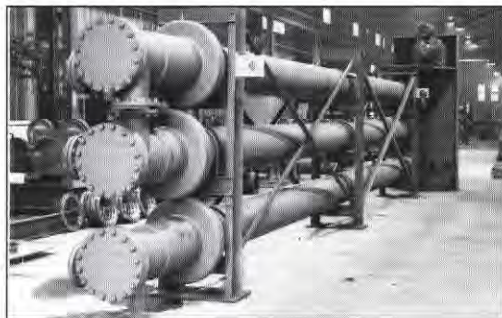
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## Briefs

Texas AgriLife Research (College Station, USA), a part of the Texas A&M System, announced it has received a private donation of cotton technology. The donation, from Monsanto Co. (St. Louis, Missouri, USA), includes about 4,000 cotton molecular markers and associated information and will be offered to the public domain through the globally accessible cotton genome databases. Richard Percy, research leader of the US Department of Agriculture Agricultural Research Service's crop germplasm research unit in College Station, manages the cotton database, which will house the information. He said the donation greatly increases the number of markers now available to the public.

"The cotton genome is very large and complex compared to other plants that have already been mapped," Percy said. "This donation will stimulate research and development in the cotton industry by providing powerful tools that will ultimately help cotton farmers get more out of every acre. This information, once full publication is made in the coming months, will benefit all breeding programs that use the database."



India became the second-largest cotton producer in the world two years ago, and annual forecasts by Texas Tech University (Lubbock, USA) agricultural economists predict it will remain in that position for years, climbing to 25.3 million acres (10.2 million hectares) in the next decade, up from 23.1 million acres (9.35 million hectares) now. Today, China leads the world in cotton production, with India and the United States at second and third, respectively. Over the next 10 years, China's share of world cotton production is expected to decline by 3%, while India's is forecasted to increase by 2%.

As a result of the faltering global economy, demand for textile products dwindled and cotton prices began to tumble in the third quarter of 2009. In

CONTINUED ON NEXT PAGE

# Biotech News



## Synthetic chemical offers possible solution for crops facing drought

Research by a team of scientists from Canada, Spain, and the United States has yielded an advance in stress tolerance for plants: the possibility of spraying stable synthetic chemicals on plants to enhance their stress tolerance during times of drought.

Plants use specialized signals, called stress hormones, to adapt to stressful conditions. Of the various stress hormones, abscisic acid (ABA), produced naturally by plants, has emerged over the past 30 years as the key hormone that helps plants cope with drought conditions. Under such stress, plants increase their levels of ABA, which helps them survive the drought through a process not fully understood. So critical is this endogenous chemical to plant survival that researchers have engineered new drought-resistant crops by tinkering with the ABA pathway.

For years, scientists have contemplated spraying ABA directly onto crops to enhance their protection in times of stress. But ABA is a costly, complicated, and light-sensitive molecule that has not found use in agriculture. The research team, led by Sean Cutler of the University of California, Riverside (UCR; USA), used a method called chemical genomics to identify pyrabactin, a new synthetic chemical that turns on the ABA signaling pathway in *Arabidopsis*. His lab then used pyrabactin to fish out a receptor for ABA. A receptor is a protein molecule in a cell to which mobile signaling molecules may attach.

"Scientists have been trying to solve the ABA receptor problem for more than 20 years, and claims for ABA receptors are not easily received by the scientific community," said Cutler. "We screened thousands of chemicals for one that mimics ABA. We found pyrabactin activates some of the ABA receptors in plants and is an excellent mimic of ABA. Moreover, unlike ABA, it is stable and easy to make."

Because of the prior questionable data in the ABA field, Cutler decided to share his data with key competitors and turn them

CONTINUED ON NEXT PAGE

response, India's government increased the minimum support price it provides its cotton farmers by 35 to 45%. India's production gains are projected to come from both increased areas and improved yields. The upward trend in yield is projected to continue as more Bt cotton varieties are approved for cultivation, as varieties are adapted to a wider range of cotton growing areas, and as utilization rates increase.



The American Soybean Association (ASA) announced in April that LibertyLink® soybeans (A2704-12) from Bayer CropScience received food safety approval from the Korean Food and Drug Administration (KFDA). This final regulatory approval in South Korea clears the way for unrestricted planting in the United States and importation into all major markets for LibertyLink soybeans, along with Roundup Ready 2 Yield™ soybeans (MON 89788) from Monsanto, which received final KFDA regulatory approval on February 27, 2009.



Bayer CropScience AG (Monheim, Germany) announced in April that it intends to consolidate its European research activities in the field of plant biotechnology at its Innovation Center in Ghent, Belgium, and further extend its activities in the main research fields of stress tolerance and increasing yields. The BioScience (Seed & Traits) division's share of Bayer CropScience's total research and development expenditure is planned to increase from 20% at present to 25% in 2012. In the course of consolidating the main research fields at BioScience, Bayer CropScience has decided to no longer pursue its research into nutrition specialty ingredients at its site in Potsdam, Germany.



Dow AgroSciences (Indianapolis, Indiana, USA), operating locally as its seed affiliate Mycogen Seeds on Moloka'i, Hawai'i, announced in late April that it had signed an agreement with Gay & Robinson Inc. (G&R) to lease land for agricultural use on the eastern ridge of Makaweli on Kaua'i. Operations on Kaua'i will begin immediately. First steps will include the setup of on-island facilities, hiring of employees for start-up purposes, and preparation of the land for planting in

into collaborators before publishing the results. Several labs working in the ABA-signaling field tested the ABA receptor that Cutler's group identified and validated their results.

"Several high-profile papers have tried to claim discovery of ABA receptors but their research could not stand the test of time, and these papers were ultimately withdrawn," said Natasha Raikhel, the director of UCR's Center for Plant Cell Biology, of which Cutler is a member. "I believe this time . . . Cutler and his team have isolated a true ABA receptor."

Study results appeared in *Science* (324:1068–1071, 2009).

## Monsanto sues over Germany's GM ban

Monsanto Co. (St. Louis, Missouri, USA) has lodged a lawsuit in protest of Germany's decision to ban a variety of the company's GM maize, Thomson Reuters reported. Cultivation and sale of MON 810 maize was banned in the country in April. Although the European Union (EU) had previously ruled MON 810 to be safe, Germany's Agriculture Minister, Ilse Aigner, defended her country's decision.

"My decision is not a political decision, it's a decision based on the facts," *The New York Times* quoted Aigner as saying. "I have come to the conclusion that there is a justifiable reason to believe that genetically modified maize of the type MON 810 presents a danger to the environment."

Aigner added that the ban did not constitute a "blanket ban" on all genetically modified organisms (GMO).

"All things that we import have been approved (at EU level) and we're not going to look at that again. This was just about one maize variety, where we had a study suggesting it was a danger to the environment," Reed Business quoted Aigner as saying.

In fact, *Chemistry World* reported in May that Aigner had approved cultivation of a genetically modified (GM) potato from BASF (Ludwigshafen, Germany), which revived doubts that the maize ban was based on scientific, and not political, reasons.

Monsanto called the maize ban "arbitrary" and maintained that the decision was "in conflict with EU rules."

"We don't really understand where this decision is coming from," Kari Matalone, a spokeswoman for Monsanto, added, pointing out that the corn "had been approved for cultivation in Europe more than a decade ago and that no ill effects had been detected since then."

A joint statement by the German Science Organisations also expressed concerns over the ban:

"The ban poses the danger that unfounded fear could take the place of rational scientific information. The minister's comment that the ban is an isolated decision on a particular case cannot compensate for the negative impact it will have on Germany's status as a research-friendly country and the fact that it is diametrically opposed to future-minded advancement.

"For all these reasons, we are fully opposed to any general ban on genetically engineered products. We urge politicians to lead a more logical discussion of the topic and to create reliable framework conditions for research into and scientific consultation on the future uses of green genetic engineering."

Monsanto's initial attempt to suspend the ban immediately, even as the lawsuit to strike it down permanently makes its way through the legal system, was rejected in early May by a German court. The Associated Press reported that a hearing date for the remaining lawsuit was yet to be set.

Germany's ban follows similar decisions in Austria, France, Greece, Hungary, and Luxembourg.

## GMO safety assessment tool released

The Norwegian GenØk—Centre for Biosafety, Third World Network (TWN), and the New Zealand INBI—Centre for Integrated Research in Biosafety announced in April the release of the Biosafety Assessment Tool (BAT), developed to aid in assessing the risks of genetically modified organisms (GMO). The BAT is a free-to-the-public, online resource to assist citizens and regulators who are reviewing scientific data provided by developers of GMO in support of their evaluation of safety.

The BAT was developed over the past five years as part of a larger Norwegian biosafety capacity-building commitment underway since the earliest days of the



Cartagena Protocol on Biosafety, an international agreement governing the movement of many kinds of GMO. Researchers from New Zealand, Norway, Solomon Islands, Malaysia, Argentina, Brazil, Mexico, France, and Germany contributed to the BAT, and the product was reviewed by researchers and regulatory officials in additional countries, including Iran, the United Kingdom, Portugal, and Ghana. During its advanced development phase, it has been used to support training of regulators, civil society leaders, policymakers, journalists, and researchers who take part in the International Biosafety Course held annually in Tromsø, Norway.

"The BAT is a living resource," according to the leader of the project's international and interdisciplinary team, molecular biologist Jack Heinemann, of the University of Canterbury in New Zealand. "The BAT has feedback provisions so that it can continue to evolve and improve. A team of researchers remains in place to grow the already comprehensive coverage of hazard identification, risk-problem formulation and evaluation, and to make the BAT more interactive" Heinemann said.

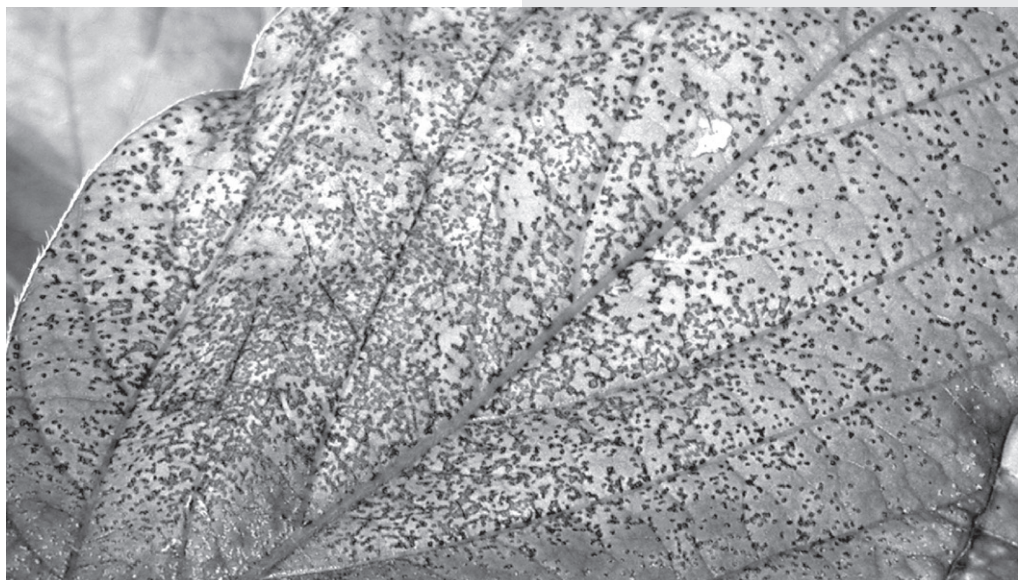
The BAT is designed for use by those with a technical background as well as those who are new to the science behind GMO and their evaluation. The tool is organized as chapters ranging from explanations of molecular methods and biostatistics to subsequent chapters specializing in genome analysis through to tests for human health and environmental effects.

"The BAT fills a much-needed gap in assisting developing countries in particular, to responsibly assess and evaluate the risks associated with GMO. This is critical for countries implementing their biosafety laws and regulations, who can now turn to the BAT as a very useful resource and scientific database," said Chee Yoke Ling, co-director, Third World Network.

For more information, visit <https://bat.genok.org/bat/home.html>.

## Rust-resistance genes in soybeans identified

A team of scientists from the USDA's Agricultural Research Service (ARS), Iowa State University (ISU; Ames, USA), and Brazil have identified a cluster of soybean genes that provide resistance to the fungus



*Phakopsora pachyrhizi*, which causes Asian soybean rust (ASR). ASR was first detected in the continental United States in 2004. Although fungicide use is effective against ASR, providing farmers with resistant cultivars is more sustainable, according to geneticist Michelle Graham. She is with the ARS Corn Insects and Crop Genetics Research Unit in Ames.

Genetic mapping previously linked ASR resistance to five DNA regions, or loci, within the soybean genome, named *Rpp1* through *Rpp5*. Screening of 15,000 accessions in the ARS soybean germplasm collection revealed how uncommon resistance is: Less than 5% of the accessions are resistant.

Graham's group sequenced the *Rpp4* locus and identified a cluster of candidate genes that confer ASR resistance. Comparisons of susceptible and resistant cultivars identified a single candidate gene, *Rpp4C4*, thought to bestow resistance. *Rpp4C4* is one of five nearly identical genes in the *Rpp4* locus. Frequent "shuffling" or recombination within the cluster allowed new disease resistance genes to be formed.

## Research yields new technique for modifying plant genes

Researchers at the University of Minnesota (U of M; Minneapolis-St. Paul, USA) and Massachusetts General Hospital (Boston,

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■ ■ ■  
Syngenta (Basel, Switzerland) and Dow AgroSciences, a wholly owned subsidiary of The Dow Chemical Co., recently announced an agreement to cross-license their respective corn traits for commercialization within their branded seed businesses. Under the terms of the agreement, Syngenta will receive global nonexclusive licenses, with stacking rights, to Dow AgroSciences' Herculex® I Insect Protection for broad lepidopteran control and to Herculex RW for corn rootworm control. Additionally, Dow AgroSciences will receive global nonexclusive licenses with stacking rights to Syngenta's Agrisure® GT trait for glyphosate tolerance and to its insect-control traits Agrisure CB/LL for corn borer and Agrisure RW for corn rootworm.

■ ■ ■  
Australia's Grains Research and Development Corp. (GRDC) and Australian Oilseeds Federation have released a booklet, "GM Canola—Performance and Experiences in 2008." It presents 13 grower case studies, four trials, and an independent demonstration of Roundup Ready canola in its first year in Victoria and New South Wales after state-based moratoria were lifted. To view the booklet, visit <http://www.grdc.com.au/uploads/documents/GM%20Canola%20Roundup%20Ready.pdf>. ■

USA) have used a genome engineering tool they developed to make a model crop plant herbicide-resistant without significant changes to its DNA.

"It's still a GMO but the modification was subtle," said Daniel Voytas, lead author and director of the U of M Center for Genome Engineering. "We made a slight change in the sequence of the plant's own DNA rather than adding foreign DNA."

For the study, the researchers created a customized enzyme called a zinc finger nuclease (ZFN) to change single genes in tobacco plant cells. The altered cells were then cultured to produce mature plants that survived exposure to herbicides. The research appeared in *Nature* (459:442–445, 2009).

"This is the first real advance in technology to genetically modify plants since foreign DNA was introduced into plant chromosomes in the early 1980s," Voytas said. "It could become a revolutionary tool for manipulating plant, animal, and human genomes."

ZFN are engineered enzymes that bind to specific DNA sequences and introduce modifications at or near the binding site. The standard way to genetically modify an organism is to introduce foreign genes into a genome without knowing where they will be incorporated. The random nature of the standard method has given rise to concerns about potential health and environmental hazards of GM organisms.

Voytas is a co-founder of the Zinc Finger Consortium ([www.zincfingers.org](http://www.zincfingers.org)), which developed a do-it-yourself strategy for academic researchers. The consortium is led by co-author J. Keith Joung, a pathologist at Massachusetts General Hospital and an associate professor at Harvard University.

Voytas' lab used ZFN created by their OPEN (Oligomerized Pool Engineering) method to modify the tobacco cells to make them herbicide resistant. According to Voytas, OPEN ZFN can be used to improve the nutrition of crop plants, make plants more amenable to conversion into biofuels, and help plants adapt to climate change. Voytas' next steps will be to apply the technology to *Arabidopsis thaliana*, a model plant, and rice, the world's most important food crop. He is also adapting algae for biofuel production.

## Report examines EU biotech

The US Department of Agriculture's (USDA) Foreign Agricultural Service (FAS) recently released GAIN Report No.

E49032, *EU-27 Planting Seeds Situation 2009*. Among other things, the report examined the role of biotechnology in the EU (European Union); its findings included:

For the past several years, yield benefits and cost savings of GE (genetically engineered) crops have made them attractive to

**TABLE I.** Member State approaches to genetically engineered seed cultivation<sup>a,b</sup>

Biotech status	Member state	Approach to biotech seed cultivation
No GE seed cultivation	Austria	Austria is against GE crops, and all Austrian provinces are members of the "European Network of GMO-Free Regions." National ordinances effectively prevent planting EU-approved GE crops. Zones restricting the use of GE seeds exist in all nine provinces.
	Bulgaria	In 2004, Bulgaria passed a biotech law that <i>de facto</i> prohibited cultivation of GE events.
	Finland	There is no commercial production of biotech crops in Finland owing to the absence of appropriate climatic conditions for cultivation of GE varieties.
	Greece	Greek legislation prevents the commercial production of GE crops.
	Ireland	It is unlikely that cultivation of and field trials for GE crops will be allowed in the near future given the current government's goal of a GE-free Ireland.
	Italy	A <i>de facto</i> moratorium on GE crop cultivation persists in Italy owing to a lack of coexistence legislation from regional governing authorities. Italy recently approved the resumption of biotech field trials after a 10-year hiatus.
	Poland	The Polish government supports a "GE-free" policy. The government banned the sale and registration of GE seeds in mid-2006. Cultivation, but not the sale, of seeds is still possible.
	Slovenia	There are neither commercial production nor GE field trials in Slovenia. This may change if the Act on Co-existence of GE Plants with Other Agricultural Plants is adopted in the future.
	Sweden	There is no commercial production of GE crops in Sweden. Several seed companies in Sweden have, however, developed GE varieties, including herbicide-tolerant rapeseed, herbicide-tolerant sugar beet, and high-starch potatoes.
	United Kingdom	There is no commercial cultivation of GE crops in the United Kingdom owing to unsuitable growing conditions for those products currently approved for cultivation within the EU. The UK government is working to achieve greater security for crop trials (there are currently potato trials), and to find solutions to coexistence among groups of regional farmers to pave the way for the possibility of commercial cultivation in the future.



Biotech status	Member state	Approach to biotech seed cultivation
No GE seed cultivation but coexistence regulations	Benelux	The Netherlands and the Belgian regions (Flanders and Wallonia) recently implemented coexistence regulations that could inhibit the cultivation of GE events, particularly in the Walloon Region. In Belgium, the Flemish sector is generally more supportive of the introduction of GE products, relative to the agricultural sector in Wallonia.
	Denmark	Denmark does not currently grow GE crops but is a strong proponent of common EU regulations on coexistence, having passed their coexistence legislation in 2004. GE corn varieties, and possibly GE potatoes, may be the first to attract producer interest.
	France	France banned cultivation of GE corn MON 810 in January 2008, pending additional domestic GE legislation and European review. Coexistence legislation passed in 2008 awaits implementing decrees.
	Hungary	Hungary maintains a moratorium on the commercial production of GE corn MON810. The Hungarian Parliament approved coexistence regulation for GE crops in December 2006. The extreme requirements of the legislation, though, have resulted in a <i>de facto</i> prohibition of commercial production of GE plant varieties.
GE seed cultivation, coexistence rules in place	Czech Republic	Czech farmers have grown Bt corn since 2005 and the Czech Republic is the second-largest producer of biotech corn in the EU. The Czech Republic's coexistence rules require isolation distances and notifications to the Ministry of Agriculture and the Ministry of Environment.
	Portugal	Commercial production of GE corn started in 2005. The current coexistence decree effectively restricts GE seed use in most corn-growing districts because the prevalence of small properties makes it difficult, if not impossible, to meet the isolation zone requirements.
	Romania	Cultivation of biotech soybeans was discontinued in 2007 when Romania acceded to the EU. In 2008, Romanian farmers planted biotech corn for commercial purposes. Coexistence regulations are in place.
	Slovakia	Slovakia has fully implemented all EU regulations on GE events. The decree administering coexistence came into force in February 2007.
	Spain	The government of Spain is supportive of Bt corn cultivation. Debate continues on a Spanish coexistence decree, the first draft of which was made public in 2004.
	Germany	Germany recently banned cultivation and sale of GMO maize; see "Monsanto sues over Germany's GM ban," page 370.

<sup>a</sup>GE: genetically engineered; GMO: genetically modified organism; EU: European Union.

<sup>b</sup>Source: US Department of Agriculture's Foreign Agricultural Service posts.

some EU farmers, and the production of these crops (currently only one corn event) continues to expand in certain Member States (MS) of the EU. Despite consumer resistance, regulatory restrictions, and a lack of political support, the area devoted to GE corn is expected to increase to approximately 110,000 hectares in 2009 (mainly in Spain, the Czech Republic, Portugal, Slovakia, and Germany).

## ASYNCHRONOUS AUTHORIZATION

Due to the lag in GE authorizations in the EU relative to the other countries, the number of GE products approved in other countries but not authorized in the EU is growing. The EU sets a zero-tolerance import level on unauthorized GE varieties. Consequently, the growing number of non-EU-authorized GE varieties subject to a zero-import tolerance is impacting the EU seed market. Importers fear that an adventitious presence (AP) of unauthorized biotech seeds in conventional seed shipments can reduce the quantity of imported seeds. At the same time, this concern prevents European seed companies and farmers from accessing the maximum range of seeds available worldwide. See Table 1 for an overview of GE seed cultivation in the various MS.

## BIOTECH TOLERANCE THRESHOLD

Because no thresholds are set in the EU for the AP of biotech events, some MS have imposed their own, while the majority maintain a strict zero tolerance. This clearly results in a situation of uncertainty both in regard to EU cultivation and imports. (The seed industry has been seeking to set threshold levels for AP in conventional seeds since 1999. Despite several reviews by the European Commission [EC] and several studies by scientific committees, the EC has failed to reach consensus on a level.) Most recently, on December 4, 2008, the EU Environment Council adopted conclusions on biotechnology that recognized the importance of the European labeling thresholds for seeds (reaffirming the need for labeling thresholds for the AP of authorized GE varieties in conventional seeds), and invited the EC to adopt appropriate thresholds as soon as possible, taking into account the most recent scientific observations. ■



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The first beauty products certified to the organic and natural Cosmos standards will not be available before the third quarter of 2010, according to CosmeticsDesign-Europe.com. The standards have been created by five certification bodies and will be published in September 2009. The participating groups include the Soil Association (UK), BDih (Germany), Ecocert (France), Cosmebio (France), ICEA (Italy), and Ecogarantie (Belgium).

■ ■ ■

Specialty chemical company Clariant of Muttentz, Switzerland, is building a surfactants plant in Zhenjiang, Eastern China, the company announced in March. The new facility is scheduled to begin production in mid-2009.

■ ■ ■

China produced 455,000 metric tons (MT) of synthetic detergents in February 2009, according to the Xinhua Economic News Service. The output in January and February reached 871,000 MT, down 6% year-on-year, the report noted.

■ ■ ■

Jayant Kumar Singh is Henkel India's new managing director, effective April 1, 2009. Prior to his appointment, he was the chairman and chief executive officer of GlaxoSmithKline Consumer Healthcare in Sri Lanka, according to the *Hindu Business Line* newspaper.

■ ■ ■

Rhodia (Courbevoie, France) announced in March 2009 that it will restructure its operations in France. Two sites will be affected, including Rhodia's Novicare phosphorus derivatives and surfactants business. The restructuring is part of a previously announced program to cut annualized costs by €150 million by 2011.

■ ■ ■

The Clorox Co. of Oakland, California, USA, initiated "Operation Flush the Outhouse Arsonist" in an attempt to catch the person or persons responsible for setting about 30 portable toilets ablaze in San Francisco since November 2008. The company offered a \$5,000 reward and a year's supply of toilet products for tips leading to the arrest of the guilty party or parties. ■

## S&D News



### Autodish phosphate bans

Some otherwise law-abiding citizens have become smugglers after Spokane County in the US state of Washington enacted the strictest US ban on automatic dishwashing (autodish) detergent made with phosphates, various press reports suggest. The ban went into effect in July 2008; it will be expanded to the entire state in July 2010.

Whereas traditional autodish products contain up to 9% phosphate, the ban limits those sold in Spokane County to containing no more than 0.5%. Thus, some residents told the Associated Press newswire they regularly travel to the border state of Idaho to purchase autodish detergent. (Such "smuggling" actually is perfectly legal; the ban only pertains to the sale of autodish detergent.)

Among other states that have banned or are banning phosphates in dishwasher detergent are Maryland, Pennsylvania, Virginia, Michigan, Vermont, Minnesota, Illinois, Massachusetts, and New York. In addition, US Senators Carl Levin (D-Michigan) and George Voinovich (R-Ohio) have introduced legislation at the national level

to limit the use of phosphates in autodish detergents.

The Levin-Voinovich bill would limit the use of phosphates in residential dish detergent by requiring the US Environmental Protection Agency (EPA), beginning in 2010, to ban the sale of residential dishwashing detergent that has more than 0.5% phosphorus. The bill also requires the EPA to review existing scientific information on nutrient excess in the waters of the Great Lakes and submit a report to Congress with recommendations for action to address the nutrient excesses.

According to the senators, a Minnesota study published in 2005 estimated that dishwashing detergent accounts for nearly 19% of the total amount of phosphorus entering municipal wastewater systems each year. The report is available at [www.pca.state.mn.us/hot/legislature/reports/phosphorus-report.html](http://www.pca.state.mn.us/hot/legislature/reports/phosphorus-report.html).

### Surfactant-free washing process

Panos Kotsakis and Neil James Parry, both of Great Britain, have developed a

CONTINUED ON NEXT PAGE

surfactant-free process for washing fabrics in a washing machine, the US Fed News Service reports.

The patent has been assigned to Unilever PLC, London; Unilever NV, Rotterdam, Netherlands; and Hindustan Unilever Ltd., Mumbai, India. According to an abstract posted by the World Intellectual Property Organization, the invention aims to disclose a “low-surfactant or surfactant-free process for washing fabrics in a washing machine comprising the steps of treating the fabrics with one or more enzymes and agitating the fabrics with a secondary agitation device in the washing machine, and a secondary agitation device for use in a primary agitation device, said primary agitation device comprising a washing machine, and the secondary agitation device containing one or more enzymes for use in the low-surfactant or surfactant-free fabric washing process.”

The invention received International Patent Publication No. WO/2009/019076, which was issued on February 19. The original patent was filed in Great Britain under application No. PCT/EP2008/058295 on June 27, 2008. It is available at <http://www.wipo.int/pctdb/en/ia.jsp?ia=EP2008/058295>.

## Are nanoparticles harmful?

Using aquatic microbes as their biosensor, scientists from the University of Toledo in Ohio (USA) suggest that nanoparticles now being added to cosmetics, sunscreens, and

hundreds of other personal care products may be harmful to the environment.

Their report was part of symposia that included almost two dozen papers at the 237th National Meeting of the American Chemical Society where scientists worked to understand the environmental and human health effects of nanotechnology. Hundreds of products utilizing these microscopic particles—1/5,000th the diameter of a human hair—already are on the market. With many more poised for debut, scientists are seeking to avoid unwanted health and environmental effects in advance.

The study by Cyndee Gruden and Olga Mileyeva-Biebesheimer focused on nano-titanium dioxide (nano-TiO<sub>2</sub>) particles found in cosmetics, sunscreens, and other personal care products. The particles are added to those products for their highly beneficial effects in blocking ultraviolet (UV) light in sunlight. Excess UV exposure can cause premature aging of the skin and skin cancer.

Gruden explained that the particles are washed down the drain in homes as people bathe. The particles then end up in municipal sewage treatment plants. From there, they can enter lakes, rivers, and other water sources where microorganisms serve essential roles in maintaining a healthy environment.

“When they enter a lake, what happens?” Gruden asked. “Would they enter an organism or bind to it? Maybe they kill it—or have nothing to do with it at all. These are important questions for determining the effects that nanoparticles may have on the environment. Right now, we are not really sure of the answers.”

Gruden studied survival of *Escherichia coli* bacteria when exposed in laboratory cultures to various amounts of nano-TiO<sub>2</sub>. She found surprisingly large reductions in survival in samples exposed to small concentrations of the nanoparticles for less than an hour. “How fast the impact was surprised me,” she said. The findings open the door to future research, including studies to determine whether the same effects occur in the natural environment.

Gruden’s method for pinpointing damage from nanoparticles uses fluorescence to identify when the cell membranes in microbes undergo damage. When membranes—a crucial part of the microbe—are damaged, the cells emit a faint red glow. “Methods based upon fluorescence allow us to obtain results faster, maybe with greater sensitivity,” she said, adding that

this approach could speed scientific efforts to understand the threshold at which nanoparticles become toxic to microbes.

The Personal Care Products Council (Washington, DC, USA) did not respond to requests for comment on the study.

## “Green” hair bleach created

Scientists from Japan have reported development of what could be the world’s first “green” hair bleach, an environmentally friendly preparation for lightening the color of hair on the head and other parts of the body without the unwanted effects of the bleaches used by millions of people each year.

Speaking at the 237th National Meeting of the American Chemical Society in Salt Lake City, Utah, USA, in March 2009, Kenzo Koike pointed out that traditional hair bleaches rely on hydrogen peroxide. Peroxide is highly effective in oxidizing, or breaking down, melanin, the black pigment that gives hair a dark color.

However, peroxide bleaches have several disadvantages. “Bleach usually has to be repeated, for example, once every three months, in order to keep the satisfactory level of color because hair grows one centimeter each month,” explained Koike, who is with the Kao Corp.’s Beauty Research Center in Tokyo. “In changing from a dark brown to a light blonde color, consumers may have to bleach several times. Repeated bleaching may compound another disadvantage of hydrogen peroxide—hair damage.”

He added that hydrogen peroxide is a harsh material. Repeated use can leave hair brittle and lifeless, with almost no attractive sheen. It also can irritate the scalp and other parts of the body.

Those unwanted effects have set scientists on a quest for milder bleaching agents, added Koike, who discussed ways to improve color removal, including making it more effective and convenient. Koike said that his new “green” hair treatment may be the long-awaited solution.

In the ACS report, he described isolation of an enzyme from a strain of *Basidiomycete ceriporiopsis*, a type of white-rot fungus that has also shown potential to degrade and clean up pollutants in soil. The enzyme naturally degrades melanin. It has the added benefit of combating the effects of free radicals—the highly reactive





agents produced by hydrogen peroxide that are responsible for its damaging effects in making hair brittle, dull, and difficult to manage.

"I think this is the first enzyme found that degrades melanin," Koike said, adding that it could be added to traditional hair bleaches to prevent hair damage, leading to hair care products that use less hydrogen peroxide.

Laboratory tests show that the enzyme is effective in bleaching synthetic melanin and melanin in human hair. Koike is working on incorporating it into conventional peroxide hair bleaches. Because the enzyme needs hydrogen peroxide to complete a chemical reaction, a small amount of peroxide would be needed for a product to work. So far, researchers are hampered by having access to only small amounts of the enzyme—a problem they expect to solve and move ahead with further tests, including clinical trials on humans.

Koike's short-term goal is pinning down how the enzyme affects melanin. "Although I expect it can degrade melanin by its oxidation, we don't know the mechanism of the reaction. We should examine it and test it more and more."

## New report on MES

The Frost & Sullivan (F&S: San Antonio, Texas, USA) research service has released a report entitled "Global Methyl Ester Sulfonate Market" that assesses the global market for methyl ester sulfonates, or MES. The three major application areas for MES include the detergent, personal care, and cleaners industries.

According to the report, the MES market currently is in a growth phase, and participants are engaged in building product awareness to increase market prospects. "A prominent aspect set to drive growth is that MES can be used as a biodegradable surfactant in detergents," the report author notes. "Usage of MES in this manner is nearly untapped, but current vibration in the surfactants market for green and biodegradable raw materials to be used may lead to potential high demand for MES surfactants." High pricing is expected to recover development cost, though some large suppliers may absorb cost through captive usage. In the current scenario, product distribution and promotions are carried out targeting selected customers at least until customers at large are ready to accept MES, the report suggests.



Emphasizing the "green" advantage of MES can deliver considerable marketing mileage, according to F&S. "Competition in this space is becoming more intense and marketing strategies at this stage will enable better product outreach and visibility, effectively communicating attributes and benefits of MES, which scores better than other anionic surfactants, particularly linear alkyl benzene sulfonate (LAS), on multiple counts," the report notes. "MES has excellent characteristics such as high purity and active level, and is devoid of any volatile organic compound (VOC). It is also gentle on the skin, has a low percentage of di-salt (around 5.0 to 10.0%), is white/near white in color, and is suitable for both liquid and powder detergents," according to F&S.

The production of MES is an expensive procedure entailing heavy investment and prior technical expertise. Feedstock for methyl esters is obtained from plant and tallow resources, and producers are dogged by feedstock availability concerns. MES supplied for the detergent market is usually a blend of C-16 methyl ester (greater than 95%) and C-18 (less than 5%). However, other cuts such as C-12 and C-14 also find their way into these markets. Palm-based feedstock is claimed to be a better source for C-16 and C-18 cuts compared with other resources. The onus is on MES producers to acquire the appropriate cuts of methyl ester. Careful selection of feedstock needs to be undertaken, and the incoming raw materials must undergo testing to ensure a competitive source.

Raising consumer awareness of MES seems to be the crucial effort required for market expansion, F&S says, adding that there are a host of potential applications in addition to detergent and personal-care formulations. For instance, MES can be used

as a flotation agent in mining. It can also be used as a de-fattening agent for leather applications because it helps dissolve fat and dirt on leather surfaces.

For more information about the report, visit <http://www.frost.com/prod/servlet/report-homepage.pag?repid=P1A5-01-00-00-00>.

## Hospital cleaning chemicals

Hospital cleaning fluids may pose a health risk to both staff and patients, according to a pilot study led by Anila Bello of Harvard University (Cambridge, Massachusetts, USA).

The study showed that common products used at six hospitals contained potentially hazardous chemicals, including ammonium chlorides, glycol ethers, and ethanolamine, all of which irritate the skin or lungs, the scientists said. The most hazardous situations were said to occur when several cleaning tasks were performed in small and poorly ventilated spaces, such as bathrooms.

Bello writes: "Because the severity of cleaning exposures is affected by both product formulation and cleaning technique, a combination of product evaluation and workplace exposure data is needed to develop strategies that protect people from cleaning hazards."

The authors concluded: "Hazardous exposures related to cleaning products are an important public health concern because these exposures may impact not only cleaning workers, but also other occupants in the building."

The study appeared online ahead of print in *Environmental Health* (doi:10.1186/1476-069X-8-11). ■

# People News/ Inside AOCS

## White named dean at Iowa State

Former AOCS president **Pam White**, University Professor of food science and human nutrition and interim dean of the College of Human Sciences, became permanent dean of the College of Human Sciences at Iowa State University (Ames, USA) in mid-April. She had been serving as interim dean since July 1, 2008. She had also served as interim dean of the College of Family and Consumer Sciences from 2003 to 2005, before it combined with the College of Education to become the College of Human Sciences on July 1, 2005. White continued as interim dean of the new college until August 31 of that year.

She earned a doctorate in food technology from Iowa State in 1981 and joined the Iowa State faculty as an instructor in food science and human nutrition in 1975.



## New president for Renewable Energy Group

**Daniel J. Oh** was named president and chief operating officer (COO) of Renewable Energy Group (REG), Ames, Iowa, USA on April 14.

He had previously been COO, and with his new title will oversee biodiesel manufacturing, sales and marketing, procurement and risk management, production operations, and technology services. He will also supervise alternative feedstock research and corporate development programs. He succeeds **Nile Ramsbottom**, who served as REG's president since the company's incorporation in 2006.



## Kent BioEnergy appoints advisory board

Kent BioEnergy Corp., San Diego, California, USA, a producer of renewable energy based on microalgae, has formed a Strategic Advisory Board. Among the members are **John R. Benemann**, an expert on bioenergy, environmental biotech, and microalgae; **Edgar Berkey**, an expert on environmental and energy issues associated with alternatives to fossil fuels; **David E. Brune**, a researcher in the fields of algae wastewater treatment and bioenergy; **David R. Dodds**, an expert in biocatalysis, process chemistry, and molecular biology; and **Tryg J. Lundquist**, a researcher in the areas of algae-based wastewater reclamation technologies and algae biofuel systems.

## New officers for US Soybean Federation

During a March meeting of the board of directors of the US Soybean Federation (USSF), **Warren Stemme**, a soybean farmer from Chesterfield, Missouri, was elected USSF president. **Jerry Slocum**, a soybean farmer from Coldwater, Mississippi, vice president; and **Bill Zurn**, a soybean farmer from Calaway, Minnesota, secretary/treasurer. Also during the USSF board meeting, directors approved a new state affiliate, the Nebraska Soybean Federation.

USSF was created by soybean farmers from Minnesota, Missouri, and Mississippi to represent US soybean farmers through policy and advocacy efforts in Washington, DC.

## Steinemann becomes CEO of Barry Callebaut

The Board of Directors of cocoa and chocolate products manufacturer Barry Callebaut has appointed **Jürgen B. Steinemann** to the position of chief executive officer (CEO), effective August 1, 2009. He had previously been COO of Nutreco Agriculture, an animal nutrition and fish feed company.

Steinemann replaces CEO **Patrick De Maeseneire**, who worked for Barry Callebaut for seven years, during the time that two companies, the Belgian chocolate producer Callebaut and the French chocolate company Cacao Barry, worked to join together and create Barry Callebaut.

## Soyatech appoints VP of sales and marketing

At the end of March Soyatech, LLC (Southwest Harbor, Maine, USA), a media, marketing, and event platform for the food, oilseed, and agribusiness industries, announced that **Mark Dineen** had joined the company as vice president of sales and marketing. He is responsible for overseeing the marketing of Soyatech's events, sponsorships, and exhibitions. In addition, he will further develop advertising and marketing opportunities in Soyatech's publications.

Dineen brings to his new position more than two decades of senior level experience in event management, sales, marketing and operations.

## US government appointments

President **Barack Obama** nominated BP's Chief Scientist **Steven E. Koonin** in late March to run the science operations of the Department of Energy. As undersecretary for the Office of Science, he will lead that office as well as the 10 national laboratories that it supports. The Office of Science also provides research and development funding to seven other laboratories. While he was with BP, Koonin guided the company's long-range technology strategy particularly in alternative and renewable energy sources.

US Secretary of Agriculture **Tom Vilsack** named **Michael Michener** as administrator of the US Department of Agriculture's



# In Memoriam

## Toru Takagi

Toru Takagi, emeritus professor of chemistry, faculty of fisheries, of Hokkaido University (Hakodate, Japan), died on April 13, 2009. He was born in 1928, and had been a member of AOCS for over 48 years.

Takagi was internationally recognized for his research on the chiral phase separations of racemic diacylglycerols and related lipids. He was best known for his innovative work on chiral chromatography, where he was the first to demonstrate resolution of a wide variety of enantiomeric lipids by chiral-phase high-performance liquid chromatography, but especially of mono- and diacylglycerol derivatives. Early in his career he made major contributions to the analysis of marine lipids in algae, echinoids, and bony fishes.

Takagi promoted the interests of AOCS in Japan, mainly through successful joint meetings of AOCS and the Japan Oil Chemists' Society (JOCS). He served as vice-president and president of JOCS from 1996 to 1999. He also supported AOCS by publishing many of his research papers in *Lipids* and the *Journal of the American Oil Chemists' Society*. He was elected a Fellow of the American Oil Chemists' Society at



the 98th AOCS Annual Meeting & Expo, held in Québec, Canada, in May 2007.

## Katalin Kövári

Born in 1946, Dr. Katalin Kövári, director of the Bunge Europe Research and Development Center in Budapest, Hungary, died on March 5, 2009. She started working in the Hungarian vegetable oil industry in 1976, and retired from Bunge in 2008. Kövári's research involved such topics as the enzymatic synthesis of alkyl esters of conjugated linoleic acid, the physical refining of sunflower oil, and the phospholipid composition of crude oils. Under her direction, Bunge developed an iodine-enriched sunflower oil for home markets in Romania as a means to alleviate iodine-deficient human diets in that country.

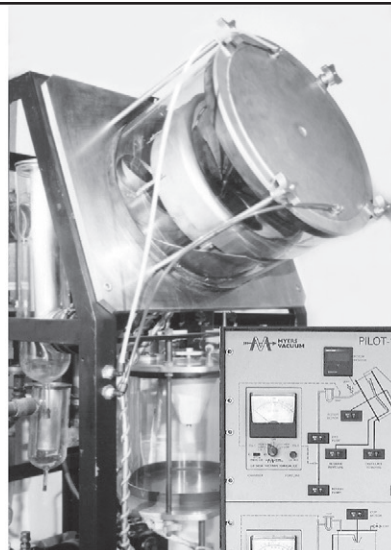
Kövári was active in national and international organizations pertaining to fats and oils. She was a board member of Euro Fed Lipid, a member of the Hungarian Scientific Society for Food Industries, and served on the FOSFA (Federation of Oils, Seeds, and Fats Associations) Technical Committee. Kövári also served as the Hungarian representative to ISF (International Society for Fat Research) and as a member of the Codex Committee on Fats and Oils. She had been a member of AOCS since 1992.

(USDA's) Foreign Agricultural Service (FAS) in March. Michener has served in three US foreign affairs agencies in the past 10 years. He has spent considerable time overseas promoting post-conflict stability operations, economic development, and human rights. FAS has primary responsibility for USDA's international activities, including market development, international trade agreements and negotiations and the collection and analysis of market information.

On April 17 Obama and Vilsack announced their intent to nominate **Rajiv J. Shah** as USDA undersecretary of Research, Education and Economics (REE) and chief scientist at the US Department of Agriculture. The REE mission area provides the science that federal agencies, policymakers, researchers, and others draw on to

meet challenges facing America's food and agriculture system. The four REE agencies are the Agricultural Research Service (including the National Agricultural Library), Economic Research Service, National Agricultural Statistics Service, and Cooperative State Research, Education and Extension Service. Shah's previous experience includes directing the Agricultural Development Program at The Bill & Melinda Gates Foundation.

Also on April 17, Obama and Vilsack announced their intent to nominate **Kevin W. Concannon** as undersecretary for Food, Nutrition and Consumer Services at the USDA. Concannon comes to the USDA with 25 years of experience as director of four health and human service agencies in three states—Iowa, Maine, and Oregon.



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# Book Review

## ***Biotechnology in Flavor Production***

Daphna Havkin-Frenkel and Faith C. Belanger (eds.)

Blackwell Publishing Ltd., 2008

232 pages

ISBN 978-1-4051-5649-3, \$184.99

### **Anakalo Shitandi**

*Biotechnology in Flavor Production* is divided into 10 chapters and includes an extensive index. The chapter authors, with backgrounds in diverse subject areas, have provided up-to-date information on flavor biotechnology. The chapters clearly demonstrate the use and benefits of biotechnology for flavor production. While the book may be challenging for some to read, it is clear and well written. The book has numerous illustrations (figures and tables) with additional color plates that enrich the text descriptions.

The 10 chapters include: The Development of Yeast Strains as Tools for Adjusting the Flavor of Fermented Beverages to Market Specifications, Biotechnology of Flavor Production in Dairy Products, Biotechnology Production of Vanillin, Plant Cell Culture as a Source of Valuable Chemicals, The Biochemistry and Biotechnology of Tomato Aroma, Flavor Development in Rice, Breeding and Biotechnology for Flavor Development in Apple, Aroma as a Factor in the Breeding of Fresh Herbs, Increasing the Methional Content in Potato through Biotechnology, and Regulatory Aspects of Flavor Development.

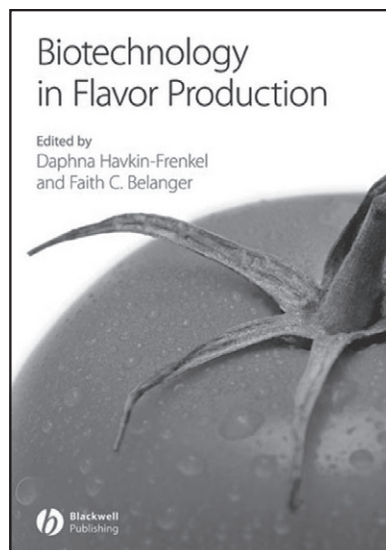
The book is likely to benefit food scientists in both the flavor and biotechnology industries, advanced students with backgrounds in biotechnology, and those in industry who deal with flavor technology. It may be of limited use to beginners and multidisciplinary learners who are not well versed in biotechnology. The book will also serve as a useful source text, due to its excellent list of references.

The text has the following strengths:

- It has a well-balanced and organized discussion. Most of the chapters are well organized and written with an introduction, a discussion, a conclusion/summary, and references.
- The contributions have been carefully selected to stress modern biotechnology as applied to flavor production common to both food science and biotechnology.
- Adequate references are provided, which will be useful for those using the book as a reference, since it will enable readers to seek more detailed and advanced information.

The index is extensive and very accurate, indicating a thorough compilation. There are, however, some shortcomings:

Chapter 1 discusses yeasts that are of particular interest. The chapter rightly discusses *Saccharomyces cerevisiae*, a yeast that has been widely used for the production of fermented food and



alcoholic beverages for a long time. The title for the chapter is a bit misleading, though, as it seems to suggest the discussion will cover ongoing research efforts to engineer strains of *Saccharomyces cerevisiae* for conditions that are different from those favored by the nonengineered wild type. If this was the intention, then the discussion is a bit limited. Perhaps in future editions the authors could consider including the influence of genetic mod-

ifications on growth and optimization of cultivation conditions of engineered strains in use for the production of flavors. *Saccharomyces cerevisiae* was the first eukaryotic organism whose genome was completely sequenced, and this knowledge has been applied in metabolic engineering to improve *S. cerevisiae* to become a more useful microorganism with new properties that have a direct relevance for flavor biotechnology.

In addition, perhaps one format could be made standard for all chapters in future versions. Chapters 5, 7, 8, 9, and 10 lack an introduction. Chapters 7, 8, 9, and 10 also lack a summary or concluding remarks. Including introductions and summaries in each chapter would be useful in giving clear perspectives of the authors' views in a text, which may attract readers whose backgrounds vary from beginner to expert in the field.

Perhaps in future editions, the authors could also consider including web links for specific information about biotechnology in flavor production. Chapter 10 made good use of these at the end of that chapter in the form of "notes."

Even with these minor shortcomings, I enjoyed reviewing the book and highly recommend it to anyone with an interest in biotechnology.

*Anakalo Shitandi has been a senior lecturer (food microbiology and biotechnology) at Egerton University in Kenya since 1992. He holds a Ph.D. in food science-microbiology from the Swedish University of Agriculture in Uppsala, Sweden.*

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# Patents

## Published Patents

### Rustproofing composition

Maeda, T., *et al.*, Honda Motor Co. Ltd., 12/9/2008, US7462226B2

A rustproofing composition has superior properties satisfying rustproofing-quality and work-quality requirements for parts around tires, parts with pockets, and plate-bonded parts, and having volatile organic solvent of not more than 10 mass %. A rustproofing composition has 5 to 60 mass % of the overall composition of at least one kind of heat-polymerized drying oil in which oil having an iodine value of not less than 130 is heat-polymerized, and 1 to 50 mass % of the overall composition of at least one kind of wax selected from natural waxes and synthetic waxes, and/or at least one kind of rustproofing additive dissolved or dispersed in mineral oil-type lubricant-based oils, synthetic lubricant-based materials or liquid saturated-hydrocarbon mixtures, vegetable oil-based semidrying oils, and vegetable oil-based nondrying oils. In the rustproofing composition, nonvolatile content at 105°C for 3 hours is not less than 90 mass %.

### Process for the transesterification of fats and oils of biological origin by means of alcoholysis using special carbonic acid salts

Peter, S., and E. Weidner, Siegfried Peter, 12/23/2008, US7468450B2

The invention relates to a process for the preparation of fatty acid esters from fats and oils of biological origin by transesterification with monohydric alcohols in the presence of basic catalysts, the catalysts being salts of a basic organic compound and carbonic acid.

### Coating for cold working metals

Church, R., Henkel AG & Co. KGaA, 1/20/2009, US7479177B2

The invention involves a composition for forming a combined conversion and lubricating coating on a metal substrate with which the composition is brought into contact. The composition comprises (i) an oxyethylated aliphatic alcohol whose aliphatic hydrocarbon moiety contains 18 or more carbon atoms and (ii) dissolved phosphate anions. Preferably the composition also comprises inorganic boron, an alkali metal salt of a fatty acid, and an accelerator for phosphate coating.

### Method of analyzing enzyme compositions with lipolytic, proteolytic, and amylolytic activity

Potthoff, A., *et al.*, Solvay Pharmaceuticals GmbH, 1/20/2009, US7479378B2

A method for analyzing the identity, protein, and/or peptide pattern and also the stability of samples containing physiologically acceptable enzyme mixtures with lipolytic, proteolytic, and amylolytic activity, particularly mixtures of digestive enzymes such as pancreatin, for use in manufacturing medicinal products comprising such enzyme mixtures, e.g., precipitated pancreatin or pancreatin mini-microspheres.

## Patent Applications

### Process for producing branched hydrocarbons

Koivusalmi, E., *et al.*, Neste Oil Oyj, 12/11/2008, US20080302001A1

The invention relates to a process for producing saturated C<sub>5</sub>–C<sub>28</sub> hydrocarbons, suitable as diesel fuels, kerosenes, and gasolines, comprising the steps where feedstock derived from starting material of biological origin is subjected to a condensation step and subsequently subjected to a combined hydrodefunctionalization and isomerization step.

### Radiation-curable coating composition derived from epoxidized vegetable oils

Gardner, K., *et al.*, Kenneth J. Gardner, 12/11/2008, US20080302694A1

Various embodiments of radiation-curable coating compositions are provided. In one embodiment the radiation-curable coating composition comprises an epoxidized vegetable oil oligomer made from the reaction of epoxidized vegetable oil and at least one of a hydroxyl functional acrylate and a hydroxyl functional methacrylate, in the presence of an acid catalyst.

### Candle composition

Wu, B., *et al.*, Premier Candle Corp., 12/18/2008, US20080307696A1

A candle composition containing nonhydrogenated oil and at least one of a long-chain hydrocarbon and a long-chain hydrocarbon derivative. A candle composition having nonhydrogenated oil and a solidifying amount of congealing reagent. A candle composition having paraffin, nonhydrogenated oil, and a solidifying amount of a congealing reagent comprising petrolatum, oxidized petrolatum, oxidized long-chain hydrocarbons, or modified hydrocarbons. A process for making a candle composition is also provided, the

process comprising mixing together a nonhydrogenated oil and a congealing amount of a congealing reagent, heating mixture to a temperature of 75–90°C, preferably 75–80°C, then cooling the mixture and pouring into a container.

## Catalytic process for converting renewable resources into paraffins for use as diesel blending stocks

Dindi, H., *et al.*, DuPont, 12/18/2008, US20080308457A1

A process for converting renewable resources such as vegetable oil and animal fat into paraffins in a single step that comprises contacting a feed that is a renewable resource with hydrogen and a catalyst that comprises a nonprecious metal and an oxide to produce a hydrocarbon product having a ratio of odd-numbered hydrocarbons to even-numbered hydrocarbons of at least 2:1.

## Easily dispersible lipidic phase

Leser, M., *et al.*, Nestec SA, 12/18/2008, US20080311211A1

The present invention relates to the use of a lipidic phase comprising an oil and a lipophilic additive (LPA), which is suitable to make an oil-in-water emulsion by application of low energy or a manual operation. The lipidic phase contains an LPA that forms self-assembly structures inside the emulsion oil droplets. The aqueous phase contains a hydrophilic emulsifier, and the lipidic and aqueous phases are mixed without using classical high shearing devices or homogenizers.

## Composition for reducing fat migration in food products

Ringhouse, T., and A. Sinclair, Vision Pharma Technologies LLC, 12/18/2008, US20080311273A1

A composition for reducing or substantially eliminating oil or fat separation in a food product is described. The composition includes a source of saturated fat and a recrystallization agent. A method of making this composition, and of using this composition in a food product, is also described.

## Composition and methods for improved lubrication, pour point, and fuel performance

Ritter, C., C.M. Intellectual Property and Research, Inc., 12/18/2008, US20080312114A1

An additive includes polyalphaolefin (PAO), a calcium source, and one or more oils from, or components derived from, beans, seeds, or roots, such as castor oil, jojoba oil, rape (canola) seed oil, palm oil, sunflower oil, soybean oil, etc. The preferred composition of matter comprises a calcium source, PAO, castor oil, jojoba oil, and a soy methyl ester and/or rapeseed methyl or ethyl ester. The additive may be used in fuels that improve combustion engine performance in terms of efficiency and emissions. The additive may be used in lubricants that improve performance of both ferrous and

nonferrous metal components of engines, guns, or other machinery. The additive also may be used in cutting fluids for machining and fabrication. Used in conjunction with other additives, embodiments of the invention may be used to lower pour points in oils, esters, and other similar products.

## Method for the synthesis of phospholipid ethers

Pinchuk, A., *et al.*, c/o Wood, Phillips, Katz, Clark & Mortimer, 12/18/2008, US20080312459A1

Disclosed are improved methods for the synthesis of phospholipid ether (PLE) analogs and alkyl phosphocholine analogs. The methods allow greater versatility of the reactants used and greater ease in synthesizing alkyl chains of varying length while affording reaction temperatures at room temperature or below. The methods disclosed herein provide reactants and conditions using alkyl halides and organozinc reagents and do not utilize Grignard reactions, thus allowing greater ease of their separation and purity of products. The PLE compounds synthesized by the methods disclosed herein can also be used for synthesizing high-specific-activity PLE analogs, for use in treatment and diagnosis of cancer.

## Method of producing lower alcohols from glycerol

Suppes, G., and R. Sutterlin, c/o Lathrop & Gage LC, 12/25/2008, US20080315151A1

A reactive-separation process converts glycerin into lower alcohols, having boiling points less than 200°C, at high yields. Conversion of natural glycerin to propylene glycol through an acetol intermediate is achieved at temperatures from 150 to 250°C at pressures from 1 to 25 bar. The preferred applications of the propylene glycol are as an antifreeze, deicing compound, or anti-icing compound. The preferred catalyst for this process is a copper-chromium.

## Amino acid lipids and uses thereof

Quay, S., *et al.*, Natestch Pharmaceutical Co., 12/25/2008, US20080317839A1

This disclosure provides a range of amino acid lipid compounds and compositions useful for drug delivery, therapeutics, and the diagnosis and treatment of diseases and conditions. The amino acid lipid compounds and compositions can be used for delivery of various agents such as nucleic acid therapeutics to cells, tissues, organs, and mammalian subjects.

Patent information is compiled by Scott Bloomer, a registered US patent agent with Archer Daniels Midland Co., Decatur, Illinois, USA. Contact him at [scott\\_bloomer@admworld.com](mailto:scott_bloomer@admworld.com).





# Extracts & Distillates

## Issues surrounding fish as a source of omega-3 long-chain polyunsaturated fatty acids

Tocher, D., *Lipid Technol.* 21:13–16, 2009.

Fish are a virtually unique, rich source of omega-3 long-chain polyunsaturated fatty acids ( $\omega$ 3 LC-PUFA) in the human diet. This article describes the origins of  $\omega$ 3 LC-PUFA in fish and the increasingly important role of aquaculture in the provision of fish for human consumption. It also highlights the major issues currently facing aquaculture, focusing on sustainability, driven by the urgent need to replace traditional fish oil and meal in formulated diets, and safety, driven by the requirement to reduce feed-derived contaminants.

## Highly sensitive quantification of key regulatory oxysterols in biological samples by LC-ESI-MS/MS

Honda, A., K. Yamashita, T. Hara, T. Ikegami, T. Miyazaki, M. Shirai, G. Xu, M. Numazawa, and Y. Matsuzaki, *J. Lipid Res.* 50:350–357, 2009.

We describe a highly sensitive and specific method for the quantification of key regulatory oxysterols in biological samples. This method is based upon a stable isotope dilution technique by liquid chromatography–tandem mass spectrometry (LC–MS/MS). After alkaline hydrolysis of human serum (5  $\mu$ L) or rat liver microsomes (1 mg protein), oxysterols were extracted, derivatized into picolinyl esters, and analyzed by LC–MS/MS using the electrospray ionization mode. The detection limits of the picolinyl esters of 4 $\beta$ -hydroxycholesterol, 7 $\alpha$ -hydroxycholesterol, 22 $R$ -hydroxycholesterol, 24 $S$ -hydroxycholesterol, 25-hydroxycholesterol, 27-hydroxycholesterol, and 24 $S$ ,25-epoxycholesterol were 2–10 fg (5–25 amol) on-column (signal-to-noise ratio = 3). Reproducibilities and recoveries of these oxysterols were

validated according to one-way layout and polynomial equation, respectively. The variances between sample preparations and between measurements by this method were calculated to be 1.8 to 12.7% and 2.9 to 11.9%, respectively. The recovery experiments were performed using rat liver microsomes spiked with 0.05 ng to 12 ng of oxysterols, and recoveries of the oxysterols ranged from 86.7 to 107.3%, with a mean recovery of 100.6%. This method provides reproducible and reliable results for the quantification of oxysterols in small amounts of biological samples.

## The integration of green chemistry into future biorefineries: Review

Clark, J.H., F.E.I. Deswarte, and T.J. Farmer, *Biofuels Bioprod. Biorefin.* 3:72–90, 2009.

The use of biorefineries for the production of chemicals as well as materials and energy products is key to ensuring a sustainable future for the chemical and allied industries. Through the integration of green chemistry into biorefineries, and the use of low environmental impact technologies, we can establish future supply chains for genuinely green and sustainable chemical products. The first step in these future biorefineries should be the benign extraction of surface chemicals; here the use of greener solvents, such as supercritical carbon dioxide and bioethanol, should be considered. The residues will often be rich in lignocellulosics, and the effective separation of the cellulose is a major challenge that may, in the future, be assisted by greener solvents, such as ionic liquids. Lignin is nature's major source of aromatics; we need new ways to produce small aromatic building blocks from lignin in order to satisfy the enormous and diverse industrial demand for aromatics. Fermentation can be used to convert biomass into a wide range of bioprocess chemicals in addition to ethanol. Their green chemical conversion to higher value chemicals is as important as their efficient production; here clean technologies such as catalysis—namely biocatalysis and heterogeneous catalysis—the use of benign solvents, and energy-efficient reactors are essential. Thermocatalytic processes for the conversion of biomass, such as the production of pyrolysis oil, will also play an important role in

future biorefineries and here again green chemistry methods should be used to go to higher-value downstream chemicals.

## Confusion over different types of n-3 polyunsaturated fatty acids

Stanley, J.C., *Lipid Technol.* 21:17–18, 2009.

There are two kinds of n-3 polyunsaturated fatty acid (PUFA). Alpha-linolenic acid (ALA) is the parent n-3 PUFA; it cannot be synthesized by the human body and, as a result, is an essential fatty acid. The two long-chain n-3 PUFA eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) can in principle be synthesized from ALA or obtained from the diet. While the cardioprotective effects of long-chain n-3 PUFA are well established, the effects of ALA on the cardiovascular system are more controversial. The Lyon Diet Heart Study, which it is claimed provides evidence for beneficial effects of ALA on the cardiovascular system, is flawed. The argument that ALA conversion into EPA and DHA provides significant quantities of the two long-chain n-3 PUFA is unsustainable as rates of conversion are too low. To avoid confusion, a distinction needs to be drawn between ALA and the long-chain n-3 PUFA. Health claims for foods rich in EPA and DHA cannot be extended to foods rich in ALA nor is ALA a substitute for EPA and DHA in vegetarian diets.

## Simple and precise detection of lipid compounds present within liposomal formulations using a charged aerosol detector

Schönherr, C., S. Touchene, G. Wilser, R. Peschka-Süss, and G. Francese, *J. Chromatogr. A* 1216:781–786, 2009.

In recent decades the use of liposomal preparations as drug delivery systems has become very attractive in pharmaceutical development. Therefore, thorough characterization and quantification of the lipids that form liposomes are wished from both investigators and regulatory authorities when the application in humans is being considered. In this study a new high-performance liquid chromatography method for the detection of lipids in liposomal

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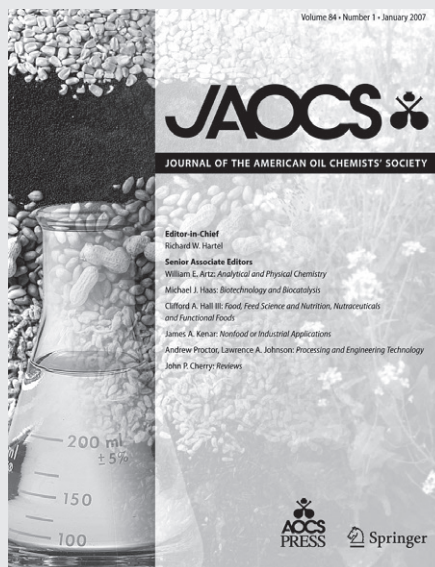
formulations was established using corona charged aerosol detection (CAD), which has the advantage to be independent of the chemical properties of the analytes. The superiority of this method over UV (ultra-violet) detection was demonstrated. Compared with UV detection, no absorption effects of the organic solvent in the mobile phase interfering with the lipid signals were observed with CAD. CAD showed good linearity ( $R^2 > 0.990$ ) for all liposomal compounds. The acceptance criteria for precision including repeatability were met. The average recovery for each of the excipients of the liposomal formulation was in the range of 90.0–110%.

### Docosahexaenoic acid supplementation and time at achievement of gross motor milestones in healthy infants: A randomized, prospective, double-blind, placebo-controlled trial

Agostoni, C., G.V. Zuccotti, G. Radaelli, R. Besana, A. Podestà, A. Sterpa, A. Rottoli, E. Riva, and M. Giovannini, *Am. J. Clin. Nutr.* 89:64–70, 2009.

Docosahexaenoic acid (DHA) intake throughout the first year of life is associated with neurodevelopmental and neuropsychological benefits. Few studies have evaluated the role of DHA intakes on age at achievement of gross motor milestones. The objective was to assess the effects of DHA supplementation throughout the first year of life on the achievement of four gross motor milestones in healthy infants. In this multicenter prospective, randomized, double-blind, placebo-controlled trial, 1,160 healthy neonates were assigned to receive supplementation with either 20 mg liquid DHA ( $n = 580$ ) or placebo ( $n = 580$ ) orally once daily throughout the first year of life. The primary end point was the time at achievement of 4 gross motor milestones (sitting without support, hands-and-knees crawling, standing alone, and walking alone). All analyses were performed on an intention-to-treat basis. The time to achievement of sitting without support was shorter ( $P < 0.001$ ) in infants who received DHA [median: 26 wk; interquartile range (IQR): 24–29 wk] than in those who received placebo (27 wk; 26–31 wk). No significant difference between infants who received DHA or placebo was found for hands-

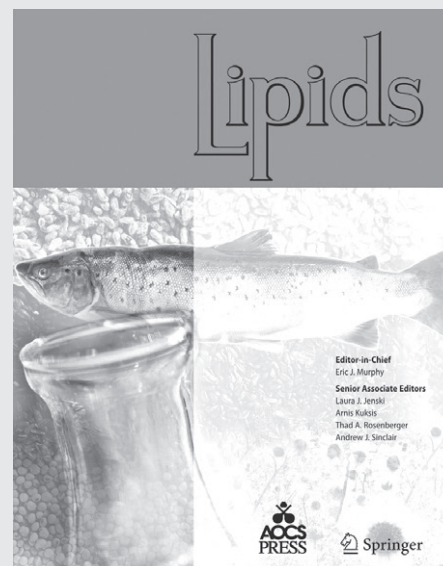
## AOCS Journals



### Journal of the American Oil Chemists' Society (May)

- Differentiation of fish oils according to species by  $^{13}\text{C}$ -NMR regiospecific analyses of triacylglycerols, Standal, I.B., D.E. Axelsson, and M. Aursand
- Fractionation of soybean globulins using  $\text{Ca}^{2+}$  and  $\text{Mg}^{2+}$ : A comparative analysis, Teng, Z., C. Liu, X. Yang, L. Li, C. Tang, and Y. Jiang
- Carob fruit polyphenols reduce tocopherol loss, triacylglycerol polymerization and oxidation in heated sunflower oil, Botega, D.Z., S. Bastida, S. Marmesat, L. Pérez-Olleros, B. Ruiz-Roso, and F.J. Sánchez-Muniz
- Selective synthesis of diacylglycerols of conjugated linoleic acid, Hernández-Martín, E., C.G. Hill, and C. Otero
- Separation of extracellular esterases from pellet cultures of the basidiomycete *Pleurotus sapidus* by foam fractionation, Linke, D., M. Nimtz, R.G. Berger, and H. Zorn
- Antioxidant activity of added phenolic compounds in freeze-dried microencapsulated sunflower oil, Velasco, J., F. Holgado, C. Dobarganes, G. Márquez-Ruiz
- The production of an experimental table margarine enriched with conjugated linoleic acid (CLA): Physical properties, Goli, S.A.H., M.M. Sahri, M. Kadivar, and J. Keramat

- Synergistic effects of antioxidants on the oxidative stability of soybean oil- and poultry fat-based biodiesel, de Guzman, R., H. Tang, S. Salley, and K.Y.S. Ng
- A process for the aqueous enzymatic extraction of corn oil from dry milled corn germ and enzymatic wet milled corn germ (E-Germ), Moreau, R.A., L.C. Dickey, D.B. Johnston, and K.B. Hicks
- Structure, protein interactions, and *in vitro* protease accessibility of extruded and pressurized full-fat soybean flakes, Jung, S., A. Mahfuz, and D. Maurer
- Optimization of enzymatic hydrolysis of chicken fat in emulsion by response surface methodology, Teng, D., R. Le, F. Yuan, J. Yang, L. He, and Y. Gao
- Effect of  $\beta$ -cyclodextrin on *trans* fats, CLA, PUFA, and phospholipids of milk fat: Method update, Alonso, L., P. Cuesta, and S.E. Gilliland
- Chemical composition and characteristics of *Commiphora wightii* (Arnott) Bhandari seed oil, Patel, B.H., S. Thakore, and P.S. Nagar



### Lipids (May)

- Sugar cane policosanols do not reduce LDL oxidation in hypercholesterolemic individuals, Kassas, A.N., S. Kubow, and P.J.H. Jones
- The carotid artery plaque size and echogenicity are related to different cardiovascular risk factors in the elderly, Andersson, J., J. Sundström,



L. Kurland, T. Gustavsson, J. Hulthe, A. Elmgren, K. Zilmer, M. Zilmer, and L. Lind

- *trans* Fatty acids and fatty acid composition of mature breast milk in Turkish women and their association with maternal diets, Samur, G., A. Topcu, and S. Turan
- Plasma LCAT activity and lipid subfraction composition in obese beagles undergoing weight loss, Angell, R., Y. Mitsuhashi, K. Bigley, and J.E. Bauer
- Lysophosphatidylcholine exhibits selective cytotoxicity, accompanied by ROS formation, in RAW 264.7 macrophages, Park, C.H., M.R. Kim, J.-M. Han, T.-S. Jeong, and D.-E. Sok
- Body compositional changes and growth alteration in chicks from hens fed conjugated linoleic acid, Leone, V.A., S.P. Worzalla, and M.E. Cook
- Conjugated linoleic acid decreases MCF-7 human breast cancer cell growth and insulin-like growth factor-I receptor levels, Amarù, D.L., and C.J. Field
- Plasma lipid transfer enzymes in non-diabetic lean and obese men and women, Magkos, F., B.S. Mohammed, and B. Mittendorfer
- Dietary n-3 and n-6 PUFA enhance DHA incorporation in retinal phospholipids without affecting PGE1 and PGE2 levels, Schnebelen, C., S. Grégoire, B. Pasquis, C. Joffre, C.P. Creuzot-Garcher, A.M. Bron, L. Bretillon, and N. Acar
- *Abies koreana* essential oil inhibits drug-resistant skin pathogen growth and LPS-induced inflammatory effects of murine macrophage, Yoon, W.-J., S.-S. Kim, T.-H. Oh, N.H. Lee, and C.-G. Hyun

and-knees crawling [39 wk (34–44 wk) compared with 40 wk (35–44 wk), respectively], standing alone [49 wk (43–55 wk) compared with 49 wk (44–57 wk), respectively], and walking alone [55 wk (50–60 wk) compared with 56 wk (52–61 wk), respectively]. Despite the 1-wk advance in sitting without support associated with DHA supplementation, no demonstrable persistent effects of DHA supplementation on later motor development milestones were found. Thus, the long-term clinical significance of the 1-wk change in sitting without support, if any, remains unknown.

### Effect of fat saturation on satiety, hormone release, and food intake

Maljaars, J., E.A. Romeyn, E. Haddeman, H.P.F. Peters, and A.A.M. Masclee, *Am. J. Clin. Nutr.* 89:1019–1024, 2009.

Ileal delivery of fat reduces hunger and food intake through activation of the ileal brake. Physicochemical properties of fat have been shown to affect satiety and food intake. The objective of this study was to assess the effect of ileal fat emulsions with differing degrees of fatty acid saturation on satiety, food intake, and gut peptides (cholecystokinin and peptide YY). We hypothesized that long-chain triacylglycerols with di-unsaturated fatty acids would increase satiety and reduce energy intake compared with long-chain triacylglycerols with monounsaturated or saturated fatty acids. We performed a double-blind, randomized, crossover study in which 15 healthy subjects (mean age: 24 yr; mean body mass index [in kg/m<sup>2</sup>]: 22) were intubated with a naso-ileal catheter and participated in four experiments performed in random order on four consecutive days. After consumption of a liquid meal, subjects received a fat or control infusion in the ileum. Fat emulsions consisted of 6 g of 18:0 (shea oil; mainly 18:0), 18:1 (canola oil; mainly 18:1), or 18:2 (safflower oil; mainly 18:2) oils. Food intake was measured during an *ad libitum* lunch. Satiety questionnaires (visual analog scale) and blood samples were collected at regular intervals. Compared with the control, only 18:2 and 18:1 significantly increased fullness and reduced hunger. No effect on food intake was observed. 18:1 and 18:2 increased cholecystokinin secretion significantly compared with the control. Fatty acid saturation did not affect peptide YY

secretion. When infused into the ileum, triacylglycerols with unsaturated fatty acids increase satiety, whereas triacylglycerols with saturated fatty acids does not. This trial was registered with the Dutch Trial Register as ISRCTN51742545.

### Metabolic syndrome and serum fatty acid patterns in serum phospholipids in hypertriglyceridemic persons with human immunodeficiency virus

Woods, M.N., C.A. Wanke, P.-R. Ling, K.M. Hendricks, A.M. Tang, C.E. Anderson, K.R. Dong, H.M.B. Sheehan, and B.R. Bistrian, *Am. J. Clin. Nutr.* 89:1180–1187, 2009.

HIV (human immunodeficiency virus) infection and its treatment are associated with abnormal lipid profiles. High triglyceride concentrations and low HDL (high-density lipoprotein)-cholesterol concentrations are the most common health abnormalities and raise concerns about an increased risk of cardiovascular disease. We compared the fatty acid patterns of serum phospholipids between persons with HIV and non-HIV controls to determine whether there are differences that explain the elevated triglyceride concentrations, insulin resistance, and inflammation that are part of the metabolic syndrome in patients with HIV. Thirty-nine persons with HIV and elevated serum triglycerides (>150 mg/dL) and/or indicators of insulin resistance were recruited to examine fatty acid profiles in serum phospholipid fractions relative to those of two control groups without HIV ( $n = 31$ ). Higher concentrations of 16:1 and 18:0 fatty acids in the phospholipid fraction indicated increased lipogenesis in the HIV patients and in the non-HIV controls at risk of the metabolic syndrome. However, the subjects with HIV had higher concentrations of both n-6 (omega-6) and n-3 fatty acids of higher elongation and desaturation levels, which indicated a greater promotion of these pathways in this population. The nanomolar percentage (%nmol) arachidonic acid was the same in all three groups. Persons with and without HIV, at risk of the metabolic syndrome, show indications of increased lipogenesis, more so in subjects with HIV taking medication. Higher proportions of distal elongation and desaturation fatty acid products were seen only in the phospholipids fatty acid fraction of the subjects with HIV. ■

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Honored Student Idit Amar-Yuli with her children, 4-year-old Inbar and newborn Sivan. Idit reports that her favorite time away from the laboratory is spent with her children and husband, Ofer.

## Meet Idit Amar-Yuli

Idit Amar-Yuli, a 2009 AOCS Honored Student, is a doctoral student under Abraham Aserin and Nissim Garti at The Hebrew University of Jerusalem in Israel. (Garti also was an award winner in 2009, having received the Stephen S. Chang Award at the 100th AOCS Annual Meeting & Expo in Orlando, Florida, USA, in May.)

A native of Israel, Amar-Yuli expects to receive her degree in 2009. She says that “although industry introduces many intellectual challenges and financial benefits, I am still considering my options regarding a postdoctoral position outside of Israel.”

Amar-Yuli’s dissertation work involves hexagonal liquid crystals and hexosomes.

“Liquid crystals are widely utilized as model systems to mimic biological processes where the phase behavior of lipids plays a mediating role,” she notes in her abstract. “In various foods, pharmaceutical, and biotechnical applications, the liquid

crystalline phases formed by surfactants in an aqueous medium represent useful host systems for drugs and vitamins.

“Various biologically active food additives require environmental protection against hydrolysis or oxidation,” Amar-Yuli continues. “Liquid crystals meet these requirements mainly due to their high solubilization capacities for hydrophilic, lipophilic, and amphiphilic molecules. We report on the solubilization of four bioactive molecules with different polarity, in three reverse hexagonal (HII) systems. The systems were composed of glycerol monooleate/tricaprylin/water and two fluid hexagonal systems containing either 2.75 wt% of Transcutol or ethanol as a fourth component.

“The phase behavior of the phases in the presence of ascorbic acid, ascorbyl palmitate, D- $\alpha$ -tocopherol, and D- $\alpha$ -tocopherol acetate were determined by small-angle X-ray scattering, and optical microscopy. Differential scanning calorimetry and Fourier-transform infrared techniques were utilized to follow modifications in the thermal behavior and in the vibrations of different functional groups upon solubilizing the nutraceuticals.” ■

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# Tocotrienols: Vitamin E Beyond Tocopherols

Ronald R. Watson and Victor R. Preedy, Editors

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This volume goes far beyond the usual considerations of vitamin E to focus on tocotrienols, which, along with tocopherols constitute the bioactive ingredients of vitamin E. Recognized as potent antioxidants, tocotrienols are associated with reducing cholesterol, suppressing tumors, and protecting the heart against oxidative stress. Compiling contributions from leading researchers, this book builds upon a recent symposium sponsored by the AOCs. It examines sources, discusses isolation, and delves into the biochemistry and chemistry of tocotrienols. The book then takes a comprehensive look at their role in health and disease, with a special focus on heart disease.

### TOCOTRIENOLS VITAMIN E BEYOND TOCOPHEROLS



EDITED BY  
Ronald Ross Watson  
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# Award of Merit presented and AOCS Fellows honored

"AOCS is near and dear to my heart," says George U. Liepa, an AOCS Fellow and recipient of the 2009 Award of Merit. Liepa is a professor of dietetics and human nutrition at Eastern Michigan University's School of Health Sciences in East Lansing (USA).

His involvement with AOCS began in 1980 and constitutes one of the longest records of service on the AOCS Governing Board in the society's 100-year history: a total of nine years. Liepa spent six years as division council representative (2000–2006), one year as secretary of the Board, and two years as a member-at-large. (He will need to return to the Board, however, to match J.C.P. Helm's record stint as AOCS secretary/treasurer, which stretched from 1925 through 1944.)

Liepa holds another distinction, albeit an unusual one: He is the only AOCS member to sleep in the headquarters building. ("In 1995, I passed through Illinois on my way to becoming department head at Eastern Michigan University. I needed a safe place to park my trailer full of books. So I called AOCS and got an invitation to camp out on a couch in the staff lounge. The only thing was, once the staff left for the day, I couldn't leave the building until they returned in the morning because of the security alarm," he remembers.)

Those lucky enough to spend time with him know he is an advocate of regular consumption of red wine and dark chocolate—for their antioxidant content, of course. In fact, he is co-author of

a paper published in the *Journal of the American Oil Chemists' Society* (JAOCS 83:985–997, 2006) entitled "How Do the Benefits of Omega-3 Fatty Acids Compare to Those of Aspirin, Alcohol/Red Wine and Statin Drugs?"

Liepa was pleased to have his two daughters, Arianne and Marisa, at the 2009 Annual Meeting & Expo (AM&E) as he received the Award of Merit. (His wife, Candice, unfortunately could not make it because of work conflicts but sent her greetings to the AOCS family.) The Award of Merit is an honor that is presented annually for service to AOCS that has "advanced the Society's prestige, standing, or interests."

Liepa's service to AOCS—in addition to his years on the Board—includes his work as chairperson of the Protein and Co-Products Section, and later in the development of the Protein and Co-Products Division. He has also served as an associate editor for *JAOCS*, as a reviewer for *Lipids*, and as a book reviewer for *inform*. In addition, he played a key role in the development of the popular "hot topic" sessions at the AM&E.

All of his work for AOCS, it should be noted, has been completed with "unbridled enthusiasm and a positive attitude," as the awards program suggests.

## 2009 AOCS Fellows honored

Also honored at the 100th AOCS AM&E were five new AOCS Fellows: Philip A. Bollheimer, John P. Cherry, Robert A. Moreau, Ragnar Ohlson, and Kathleen Warner.

The distinction of "Fellow" is given to "veteran AOCS members whose achievements in science entitle them to exceptional recognition or who have rendered unusually important service to the Society or to the profession," according to the AOCS Bylaws. Only 2% of the AOCS membership can be recognized as Fellows; with the induction of the 2009 Fellows the list currently numbers 68. For a complete list of Fellows, visit [www.aocs.org/member/awards/award.cfm?awd=fellows](http://www.aocs.org/member/awards/award.cfm?awd=fellows).

**Philip A. Bollheimer**, of Bollheimer & Associates in Memphis, Tennessee, USA, is a leader in equipment design and specification and in engineering design of processing plants for the fats and oils industry. He has been an active AOCS member for over 25 years, having served in many positions of responsibility including as Governing Board president (2007), vice president (2006), and treasurer (2002). His played a key role in guiding AOCS through difficult times and redirecting the organization on a new path. He has also mentored numerous AOCS members.



AOCS President Ian Purtle (left) presents George U. Liepa with the 2009 AOCS Award of Merit at the 100th AOCS Annual Meeting & Expo in Orlando, Florida, USA.

**John P. Cherry**—an internationally recognized authority on research leadership—retired in 2007 from the US Department of Agriculture (USDA) Agricultural Research Service's (ARS) Eastern Regional Research Center (ERRC). During his time at ERRC, Cherry saw the emphasis of the Center change from a commodity focus on milk, meat, hides, wool, oils, fats, fruits, and vegetables to becoming a premier food safety and research center.



Cherry has been an AOCS member for 27 years, serving as editor-in-chief of the *Journal of the American Oil Chemists' Society* (JAOCS) from 2001–2005. He has also been an officer of the Protein and Co-Products Division, serving as chairperson in 1992. Cherry is a Fellow of the Institute of Food Technologists and the American Chemical Society. He received the prestigious US Presidential Rank Award in 1992 and 2001.

**Robert A. Moreau** is a research chemist with the USDA-ARS ERRC. His pioneering work includes the development of analytical methods for high-performance liquid chromatography, the evaporative light-scattering detector, and the charged aerosol detector, as well as the development of corn milling technology.



Moreau has been an active member of AOCS for almost 20 years, serving as Publications Steering Committee chairperson (2002–present), associate editor of *Lipids* (1997–present), canvassing chairperson for the Schroeffer Award (2002–present), and chairperson for numerous technical sessions at AOCS meetings. In addition, he helped forge the partnership between AOCS and Springer, which has had a profoundly positive effect on both AOCS and its journals.

Moreau received the AOCS Herbert Dutton Award in 2006 and the ARS Technology Transfer Award in 1998 for the development of Amazing Oil, a cholesterol-lowering edible oil made from the hulls of corn kernels.

**Ragnar Ohlson** of Haverdal, Sweden, is an authority on rapeseed oil and protein and has conducted research on new products from renewable resources. He was research manager at Karlshamns for many years and held several academic positions in Sweden, although he is now retired.



Ohlson has been an AOCS member for over 45 years. As general secretary of the International Society for Fat Research (ISF)—a post he held for more than 10 years—he was instrumental in

AOCS being named secretariat for ISF. Ohlson brought an international perspective to the AOCS Governing Board during his service in the 1990s, and played a significant role in the formation of the AOCS European Section.

Ohlson received the Julius Lewkowitsch Memorial Lecture Award given by the UK's Society of Chemical Industry. He is also a member of the Swedish Academy of Science, by appointment of the King of Sweden.


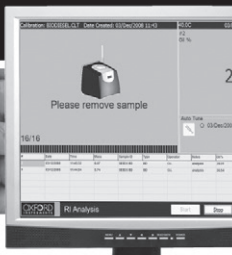
**Kathleen Warner**, lead scientist, USDA-ARS, National Center for Agricultural Utilization Research, USA, has made significant contributions to and established a national and international reputation in lipid oxidation, antioxidant, and frying oil chemistry.



She has been a member of AOCS for over 30 years and has served as a member of the Governing Board (1993–1998), as associate editor of *JAOCS* (1992–1998), and as technical program chairperson for the 1998 AOCS Annual Meeting & Expo. In addition, she has served on numerous technical methods committees, including the Uniform Methods Committee (1988–present). She has also served as chairperson of the Lipid Oxidation and Quality Division (1991).

The 101st AOCS Annual Meeting & Expo will be held in Phoenix, Arizona, USA, on May 16–19, 2010. For information about how—and when—to nominate a colleague for an award that will be given at that meeting, visit [www.aocs.org/member/awards](http://www.aocs.org/member/awards). Self-nominations are also welcomed and encouraged.


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# Diacylglycerol oil: Healthful or hype?

Ling-Zhi Cheong and Oi-Ming Lai

In diacylglycerols (DAG) two of the hydroxyl groups of glycerol are esterified with fatty acids (FA). DAG can exist in three stereochemical forms: *sn*-1,2-DAG, *sn*-1,3-DAG, and *sn*-2,3-DAG. The structures of various isoforms of DAG are shown in Figure 1.

As a minor component occurring naturally in various edible oils at levels up to about 10% (w/w), DAG formerly received little attention. Their main use was as emulsifiers in the food industry. In the late 1990s, though, DAG attracted attention for their potential as a more healthful form of oil. DAG oil has become well accepted in the Japanese market; 70 million bottles having been sold since it was launched in 1999. In gaining acceptance in such short a period of time, one might wonder whether DAG oil is merely another instance of hype, cleverly designed by marketers. It is undeniable, though, that DAG possesses clinically proven healthful properties such as reducing postprandial lipid level, increasing  $\beta$ -oxidation of fats, as well as managing and preventing obesity (Takase, 2007). In fact, healthful properties of DAG oil were recognized by the Japanese government with the granting of food for specific health use (FOSHU) status.

Tomonobu *et al.* (2006) recently conducted a double-blind placebo-controlled crossover study in which healthy adults ingested a 500 kcal test meal containing protein (29.9 g), fat (18.8 g), carbohydrate (50.8 g), and DAG- or TAG (triacylglycerol)-incorporated mayonnaise (10 g DAG or TAG/15 g mayonnaise). Subjects ingesting DAG-containing mayonnaise had significantly ( $P < 0.05$ ) lower postprandial lipid levels than subjects ingesting TAG-containing mayonnaise.

The healthful properties of DAG lie in how they are metabolized. Having only two FA attached to glycerol, DAG (particularly *sn*-1,3-DAG) is metabolized differently from TAG. Pancreatic

lipase, which is 1,3-specific, hydrolyzes DAG into free fatty acid (FFA) and 1(3)-monoacylglycerol (MAG). As 1(3)-MAG poorly re-esterifies into TAG, formation of fat-rich particles (chylomicrons) that have the tendency to obstruct capillary vessels and deposit in adipose tissue is lower. On the other hand, pancreatic lipase hydrolyzes TAG into FFA and 2-MAG, which normally re-esterifies into TAG and is released as fat-rich particles. Although DAG oil is metabolized in a different manner from TAG, it has the same energy values and absorption coefficients as conventional TAG oil, thus indicating that the healthful properties of DAG are indeed due to the difference in fat metabolism. Unlike TAG, which is deposited as fats, DAG is burned as energy.

Another issue concerning consumption of DAG oils is their toxicological effects. Since its launch in 1999, there have been no reports of deleterious effects of DAG oil consumption on human health. In a human clinical trial that lasted for a year, DAG oil consumption had no adverse effects on indicators of toxicological interest, such as the levels of liver enzymes in serum, and glycemic regulation, and clinical chemistry indicators. In fact, DAG has been granted the GRAS (Generally Recognized as Safe) status by the US Food and Drug Administration. Additionally, approval dossiers on the safety of DAG consumption have also been submitted to the European Union, Canada, Australia, and New Zealand.

## PRODUCTION ROUTES OF DAG OILS

Generally, DAG can be produced through esterification of FA or their derivatives to glycerol, glycerolysis between TAG and glycerol, hydro-

lysis of TAG, or a combination of these methods.

Studies on esterification of FA or their derivatives to glycerol to produce DAG have been quite extensive. In a nutshell, this process can be quite costly owing to its use of expensive FFA as a raw material. To reduce the production cost, Lo *et al.* (2004) reported utilizing lower-cost FA distillates as raw material to produce DAG with a purity of 60%. However, this process requires use of an immobilized enzyme as catalyst, which may raise the overall production cost.

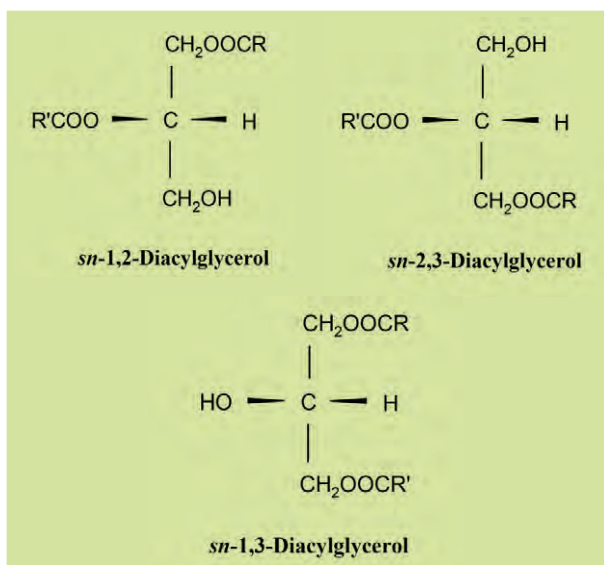


FIG. 1. Structures of various isoforms of diacylglycerols (DAG).

Kristensen *et al.* (2005) described a glycerolysis process of sunflower and rapeseed oil to produce DAG. Some interesting aspects of this study were the lowered reaction temperature and the addition of MAG to shift the reaction equilibrium toward higher DAG yield. In glycerolysis processes involving enzymes, consideration must be given to the type of enzyme carriers used, as hydrophilic carriers tend to clump during reaction and result in lower yields.

In 2007, Cheong *et al.* reported using a commercial immobilized lipase to catalyze the hydrolysis of TAG under controlled conditions to produce DAG. The advantage of this process lies in the single-step hydrolytic process without further addition of substrates such as glycerol. However, precise control of water content during the hydrolytic process is crucial in producing DAG with high purity.

These production processes usually involve the use of enzymes or chemical catalysts. Enzymatic reaction is energy efficient, with mild reaction conditions (50–60°C), but incurs high catalyst cost. Chemical reaction, however, has higher energy consumption (180–240°C) but significantly lower catalyst cost.

In recent years, application of solvent engineering in enzymatic reactions has increased for a number of reasons. One of the reasons for using solvent is to enhance lipase stability and activation, which consequently contribute to improved reaction efficiency. Besides that, solvents also help with dissolution of immiscible substrates

DAG isomers. It also has been proposed that the hydroxyl group of DAG acts as an antioxidant group, similar to a sugar alcohol, which leads to the oxidative stability of DAG being greater than or equal to that of TAG. Having a hydroxyl group attached to the glycerol also increases the hydrophilicity, emulsification properties, and water-retaining ability of DAG.

Although not extensive, a few studies have been done on crystallization behavior of DAG. Depending on their isomers, DAG can exist in both  $\beta'$  and  $\beta$  crystals. One of the interesting aspects of the crystallization behavior of DAG is their ability to delay the transformation from  $\beta'$  to  $\beta$  crystal. Most fats can solidify in more than one crystalline pattern, namely, the  $\alpha$  form, the  $\beta'$  form, and the  $\beta$  form. In most edible fat applications, the  $\beta'$  form is desirable. Owing to its fine network and great surface area, the  $\beta'$  form is capable of immobilizing a large amount of liquid oil and aqueous phase droplets. Hence, it gives a smooth, continuous, and homogeneous texture. Nevertheless, during storage, the  $\beta'$  form usually transforms into the more stable  $\beta$  form. Unlike the  $\beta'$  form, the  $\beta$  form gives a grainy and rough texture. Hence, the ability of DAG to stabilize the  $\beta'$  form and delay transformation into the  $\beta$  form imparts a desirable property to edible fat applications.

## FOOD APPLICATIONS OF DAG OILS

Unique physicochemical properties coupled with healthful characteristics have made DAG a very attractive food constituent at present. Besides cooking oil, DAG can also be used in numerous other food applications, including emulsified food products such as margarine, mayonnaise, salad oils, and salad dressings and edible fat products such as shortenings, confectionery fats, ice cream fats, baked food products, and beverages. Made with DAG, some of these products have been produced and reported to have equal or even better performances and organoleptic properties than conventional TAG products.

DAG cooking oil has been studied for thermal deterioration and evaluated for sensory acceptance. In comparison with TAG cooking oil of equal FA composition and tocopherol content, thermal deterioration of DAG cooking oil was not significantly different ( $P > 0.05$ ). Both DAG and TAG cooking oils were reported to have similar deterioration indices such as peroxide value and *p*-anisidine value. DAG cooking oil underwent hydrolysis more rapidly than TAG cooking oil, however, which was reflected in higher acid value. Nevertheless, the hydrolysis of DAG oil was not related to thermal deterioration. It was attributed to the presence of the hydroxyl group in the DAG structure that resulted in a higher affinity for water molecules. In terms of sensory evaluation, both DAG and TAG cooking oil produced products of similar sensory acceptance.

We recently studied the baking performance and sensory acceptance of palm-based DAG bakery fats and compared them with those of palm-based TAG bakery fats. We found cakes produced from palm-based DAG bakery fats had higher specific volume, moistness, and a softer and airier texture. DAG, which is an emulsifier, facilitates the dispersion of the fat phase and aqueous phase, thus enhancing air incorporation and water-holding capacity of the cake batter. The higher moistness and softer/airier texture of the cakes produced from palm-based DAG bakery fats generated significantly ( $P < 0.05$ ) higher sensory acceptance.

Cookies produced from palm-based DAG bakery fats had an insignificant ( $P > 0.05$ ) reduction in spread compared with TAG bakery fats but a softer texture and higher compactness. These

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## Unique physicochemical properties coupled with healthful characteristics have made DAG a very attractive food constituent at present.

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and dispersion or partitioning of enzymes through the reaction medium. Several studies also demonstrated that solvent polarity plays a role in influencing the selectivity of lipases. Despite the beneficial effects in enhancing reaction efficiency, solvent engineering in enzymatic reactions has been deemed undesirable as it may pose problems in waste management and thus be environmentally unfriendly.

With consumer spending trends favoring green products, carrying out an enzymatic reaction in an ionic liquid has great potential. As a reaction medium, ionic liquids offer advantages beyond green solvents. Their ability to enhance enzyme stability, shift reaction equilibria, and increase recyclability and recoverability of enzymes translates to enzyme cost efficiency. In fact, Guo *et al.* (2005) demonstrated the potential for the industrial application of lipase-catalyzed glycerolysis of fats and oils in ionic liquid for the production of MAG, including high product yield (90% MAG) and excellent operational stability and reusability of enzyme.

## PHYSICOCHEMICAL PROPERTIES OF DAG OILS

To date, few of the physicochemical properties of DAG are known at a fundamental, as well as a practical, level. The presence of a hydroxyl group dictates the differences in physicochemical properties of DAG and TAG. For example, DAG have higher melting points than TAG, owing to the strength of the hydrogen bonding of the hydroxyl group and fatty acid chain arrangement of the



attributes are due to the hydroxyl group in DAG, which retains more water during baking, thus enhancing gluten development. As the changes in texture were not significant, sensory acceptance of cookies from palm-based DAG bakery fats was found to be similar to that of palm-based TAG bakery fats.

## FUTURE PROSPECTS FOR DAG OILS

As the obesity epidemic and incidence of lifestyle-related diseases continue to grow, consumer spending trends will likely move toward healthful and functional food products. DAG oil, which is a functional food with the ability to reduce body weight and blood lipid levels, is in a position to emerge as an attractive food constituent. Although much research on production routes of DAG has been carried out, greater emphasis is required to further reduce the high production cost. With a lower production cost, it is conceivable that DAG oil will make waves in the food industry.

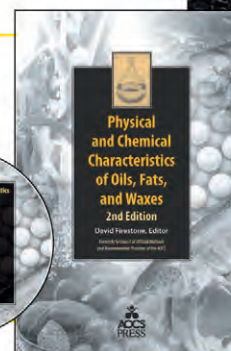
Ling-Zhi Cheong is a postdoc in the Department of Molecular Biology, Aarhus University, Denmark. She can be reached at [cheong@mb.au.dk](mailto:cheong@mb.au.dk). Oi-Ming Lai is a member of the Department of Bioprocess Technology, Faculty of Biotechnology and Biomolecular Sciences, University Putra Malaysia. She can be reached at [omlai@biotech.upm.edu.my](mailto:omlai@biotech.upm.edu.my).



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# The battle over hydrogenation (1903–1920)

## Part II. Litigation

**G.R. List and M.A. Jackson**

*Editor's note: Crisco shortening manufactured under patents issued to John Burchenal and Edwin Kayser first appeared in 1911 and was the first such product made from hydrogenated vegetable oils. By 1914 a similar product appeared on the market under the name Kream Krisp. This product was marketed by Berlin Mills Co., located in New Hampshire, and was covered by their own US patents (1,121,860 and 1,184,480, December 11, 1914, and May 23, 1916, respectively). Procter & Gamble brought suit against Berlin Mills for infringement of the Burchenal patent. This article will document the court proceedings, which lasted from September 1916 until December 1920, when the US Supreme Court invalidated the Procter & Gamble patents. Part one of this series appeared in the June 2007 issue of inform (18:403–405).*

### PROCTER & GAMBLE SUES BERLIN MILLS IN US DISTRICT COURT

Litigation of the Burchenal patent US 1,135,351 began on September 23, 1916, in the US District Court, southern district of New York. Procter & Gamble, as plaintiff, was represented by the firm Allen and Allen, while Barrow and May represented as defendant Berlin Mills Co. From the outset it was clear that Berlin Mills would show that if, indeed, anything was patentable, it was the invention of Edwin Kayser, not John Burchenal.

The patent in question had seven claims, of which only one and two were contested. Claim one: "A homogenous lard-like product consisting of incompletely hydrogenised [*sic*] vegetable oil" and claim two: "A homogenous lard-like product consisting of incompletely hydrogenised [*sic*] cottonseed oil."

The 55-year-old John Burchenal, who had been business manager at Procter & Gamble since 1886, was the first defense witness for Berlin Mills. Mays very carefully attempted to show that Burchenal was not a chemist, nor did he have any technical knowledge of the hydrogenation process or the relationships between the physical and functional properties of hydrogenated oil. Marcus Allen repeatedly objected not only to this line of questioning but also to references to the Kayser patents as being immaterial.

Mays showed that Procter & Gamble's hydrogenation process was a batch system, whereas Berlin Mills used a continuous hydrogenation process and, although the products, Crisco and Kream

Krisp, had about the same melting point, their compositions were different. Analysis of Crisco showed that it was formulated by the hydrogenation of cottonseed oil to an iodine value (i.v.) in the 65–82 range, whereas Kream Krisp was hydrogenated to a lower i.v. and then blended with additional liquid oil. Crisco showed the following composition: saturates 20–25%, olein [*sic*] 65–75%, linolein [*sic*] 5–10%, melting point 33–40°C; Kream Krisp: saturates 28%, olein [*sic*] 34.3%, linolein [*sic*] 37.7%, melting point 35.1°C, i.v. about 95.

The trial lasted about a year, and the opinion was delivered October 3, 1917; it ordered (i) the Burchenal patent suit US 1,135,351 was void for lack of invention, (ii) claims one and two of said patent were not infringed by the defendant, and (iii) the bill of complaint be and same were dismissed, with court costs to the defendant to be taxed by the clerk of the court



### PROCTER & GAMBLE APPEALS US DISTRICT COURT DECISION

Procter & Gamble appealed to the US Circuit Court of Appeals for the Second Circuit on the basis that Burchenal's patent was valid. The appeal was heard on October 10, 1918, with Judges Henry Galbraith Ward, Henry Wade Rogers, and Charles Merrill Hough presiding. In writing for the majority, Judge Hough said:

*"The patent declares this (Crisco) is a description of a visible, tangible thing which, for some time, has been manufactured and sold by plaintiff, as to which, there is no evidence that anybody else ever made it before, or that, if this product is entitled to patent protection, there is clearly related prior art.*

*"Invention [i.e., the Burchenal patent] is denied, on the ground once taken by an examiner in the office, namely that 'If the problem of simulating lard were presented to an oil chemist, an incomplete hydrogenation of the cottonseed oil would, at once, suggest itself to him as a solution to the problem.' That is (a), the matter is so obvious as not to rise to the dignity of invention.*

*"Another objection is that the hydrogenation of vegetable oils is not new. Prior to Burchenal's effective date, it is admitted that the catalytic hydrogenation of an oil had been practiced, at least, in well-known laboratories and a hard stock produced, solid at ordinary temperatures and showing, on analysis, a very large percentage of stearic or palmitic acid. It is obvious that, if one starts with cottonseed oil, which is liquid at room temperature, because it has too little solid fat in it, and, by chemical means, so changes the molecular composition or arrangement of the substances as to increase the ratio of solid fat, there must have been a time during development of the process when the union of hydrogen had progressed far enough to convert the liquid to a semi-solid.*

*"Therefore, it is said (b) that no man is entitled to a patent upon the thing or product which has always been produced when the process of making another thing or product was half done.*

*"The third objection to invention is substantially this: The merit or value of what Burchenal claims and what the plaintiff makes and sells looks like lard, acts like lard, and can be used for the purposes of lard without offending the conservatism of chefs, housewives, and maid servants. But, before Burchenal, many inventions were made by mechanically mixing hard animal fats and cottonseed oil in varying proportion, and some of these mixtures show, upon analysis, substantially the same chemical characteristics as are shown by Burchenal's chemically produced, homogeneous semi-solid. Therefore, it is said that to make the same thing as had been made by earlier lard imitators, but in a different way, cannot warrant a patent upon the resulting thing or product, whatever may be produced, may be true, in respect of the process, by which that product is reached. This is as much to say that the Burchenal product, when completed and ready for use, must be old, because other men had earlier arrived at the same chemical result by other paths."*

Judge Hough continued:

*"Objection (a) raises the question of fact encountered in a large proportion of patent causes and, concerning which discussion, is of small value if the record discloses no one ever tried to do the same thing in the same way. When novelty, in that sense, appears the question, really is one of measuring foresight by hindsight. The problem seems easy now, but when that object reached was desirable, useful and apt for commercial success, the bold fact that nobody ever did it before is persuasive, though, and not conclusive evidence of some invention. Burchenal's imitation lard had these attributes and we consider it a sufficient answer to the statement that any oil chemist could have done the same thing. To note that no oil chemist did do it during the more than score of years prior to Burchenal's application when cottonseed oil (especially)*

*as an abundant American product was endeavoring to supplant lard in the American market.*

*"The next objection to invention (b) really denies the possibility of invention ever residing in noting or discovering a use for something which, if naturally a by-product, may be termed a half-product or unfinished product of an existing method or procedure. Without resorting to the extreme doctrine of Potts vs. Creager (155 US 597), it seems to us that the question presented by this record depends on whether the thing produced by partial hydrogenation is a different thing from that which existed before hydrogenation began and that which would exist when it ended.*

*"The patent law does not speak in terms of science, though scientific evidence is necessary for the application of its rules. The chemical composition of steam, water, and ice is the same, but they are different things, and, in the same common sense, any oil, lard, and stearin are different things, although (with some latitude) the oil may be said ultimately to become stearine and to pass through the lard stage on the way. For substantially the same reasons we think there is nothing in the last (c) objection to invention. It may be assumed as true that by the mixture of cottonseed oil and animal stearine, a substance can be produced which, for practical purposes, is the same thing as Burchenal's chemically changed cottonseed oil, but one is a mixture and the other is not, assuming the differences to be unimportant from the stand point of either chemist or cook, it is a vital difference from that of the law. We are therefore of opinion that there was invention in Burchenal's disclosure."*

## US SUPREME COURT RESOLVES THE ISSUE

The case was argued before the US Supreme Court on November 15, 1920, and decided on December 6, 1920. The opinion of the court was delivered by Judge William B. Day. In essence, the court ruled with the district court and reversed the appellate court decision. The full text of Judge Day's opinion can be found online at <http://supreme.justia.com/us/254/156/case.html>.

Judge Day was no stranger to controversial cases. By the early part of the 20th century, Congress began use of the commerce clause of the US Constitution to ameliorate social problems of which child labor was one. Others include interstate gambling, adulteration of food, and prostitution. Thus, in 1916, Congress enacted the Keating-Owen Child Labor Act, which used the commerce clause to bar goods made by children from interstate commerce. The law prohibited interstate commerce of any merchandise made by children under the age of 14 or that had been made in factories where children between 14 and 16 years worked for more than 8 hours, worked overnight, or worked for more than 6 days a week.

Roland Degenhart, who worked in a cotton mill in Charlotte, North Carolina, along with his two sons, sued, arguing that the Keating Act was unconstitutional. In a bitterly divided court (5–4), Judge Day, writing for the majority, stated that Congress has no power under the Constitution to force child labor laws on the states and to do so would destroy the federalism established under the 10th amendment.

Judge Day, 59th associate justice, authored 439 opinions while on the court (1903–1922) and only 18 dissents. His record clearly shows he distrusted large corporations and voted with the anti-trust



majority in a number of landmark cases, including the breakup of Standard Oil under the Sherman Anti-Trust Act of 1890.

In 1920, Judge Day could not have possibly known what nearly 90 years of history has revealed regarding the edible oil industry. In the 1920s, soybean oil in the United States was nothing more than a laboratory curiosity, and it would take another 20 years before soybean oil became a replacement for cottonseed oil.

The decision by the US Supreme Court to uphold the Burchenal patent would have given Procter & Gamble a monopoly on the shortening industry and the use of hydrogenation to manufacture edible products for 20 years. Although Judge Day was not about to let that happen, history does vindicate his decision. It would take another 30 years or so, but hydrogenation would become the backbone of the edible oil industry for many years.

## CONCLUSION

The patent law has four requirements. An invention must be (i) statutory, (ii) new, (iii) useful, and (iv) nonobvious or extending beyond the prior state of the art. The reading of the transcripts from the trial clearly show that the knowledge of hydrogenation in the 1916–1920 era was very meager indeed and very little prior art existed. Technical experts of the day viewed cottonseed oil as linoleate glyceride being converted to oleate, or directly to stearate. There is no evidence that the chemists of the day recognized that isomerization to elaidic acid was occurring or that mixtures of

elaidic, stearic, and palmitic glycerides account for the functional properties of hydrogenated fats.

Hugh Moore, chief chemist at Berlin Mills, published the first paper on hydrogenation to be found in the open literature (*Ind. Eng. Chem.* 9:451–462, 1917), Moore concluded that little, if any, selectivity occurs during hydrogenation of cottonseed oil with nickel catalyst. By 1924, A.S. Richardson, Procter & Gamble, reported in the same journal that the analytical methods used by Moore were faulty and, indeed, selectivity occurs. That is, the conversion of linoleate to oleate occurs faster than oleate to stearate.

It should be noted that compound shortenings or lard substitutes were on the market some 25–30 years prior to the Crisco court case. Most notable were Cottolene and Cottosuet prepared by blending liquid cottonseed oil (70–80%) with beef stearines (20–25%). Cottolene was first sold by N.K. Fairbanks in 1887, and Swift introduced Cottosuet in 1893. Both products remained popular well into the 1930s. Thus, by 1920, the issue of new (novelty) was no doubt influenced by the widespread popularity of these compound shortenings.

*G.R. List (retired) and M.A. Jackson, both of the New Crops Research, National Center for Agricultural Utilization Research, Agricultural Research Service, US Department of Agriculture, appreciate the assistance of Ed Rider, Procter & Gamble Co., for the use of the court transcripts of the case. Contact G.R. List at [grlist@telstar-online.net](mailto:grlist@telstar-online.net).*

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# Pittcon 2009

**Marguerite Torrey**

This year the 60th Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy, or Pittcon 2009, was held March 8–13 at McCormick Place in Chicago, Illinois, USA. Total registration was 19,018 conferees and exhibitors from 90 countries, down considerably from the 2007 meeting (*inform* 18:353–355, 2009) total of 22,213 but down only slightly from the 2008 meeting (19,356). In considering the current world economic crisis, the 6% increase in the number of conferees (nonexhibitor attendees) in 2009 compared with 2008 may seem unexpected, but on the other hand exhibiting companies were 1,006, a decline of 14% from 2008 to 2009. The Exposition also featured a new area called the Green Corner where 13 companies displayed products and services for green chemistry solutions, resource conservation, and laboratory pollution prevention techniques.

Besides the instrumentation exhibit, there were more than 2,200 technical presentations. There also were 55 symposia, 15 workshops, and 136 short courses covering 60 different topics. For the second year, conferee networking sessions, with topics suggested by conferees, were held (see sidebar, page 399) and adjudged to be successful.

For the third successive year the American Chemical Society Division of Analytical Chemistry contributed to Pittcon. Other organizations contributing in this manner were the Japanese Analytical Instrument Manufacturers Association, Society for Applied Spectroscopy, and the Society of Electroanalytical Chemistry.

## AWARD WINNER

Members of the press attending Pittcon were invited to indicate what they thought were the best new products presented at the conference. The Silver Editors' Award went to the *i*TOC-CRDS (isotope Total Organic Carbon–cavity ring-down spectroscopy) analyzer, which is produced jointly by OI Analytical (College Station, Texas, USA) and Picarro Inc. (Sunnyvale, California, USA). The compact, turnkey system oxidizes organic compounds in aqueous samples in the OI Analytical TOC Analyzer in a reaction chamber using heated sodium persulfate (Fig. 1). Alternatively, solid samples can be placed in a quartz crucible and oxidized by high-temperature combustion in the solids module.

The CO<sub>2</sub> produced by either method is then introduced into the Picarro isotopic CO<sub>2</sub> analyzer for determination of the <sup>13</sup>C/<sup>12</sup>C isotope ratio ( $\delta^{13}\text{C}$ ) by CRDS, an alternative to a mass spectrometer.



**FIG. 1.** *i*TOC-CRDS (isotope Total Organic Carbon–cavity ring-down spectroscopy) analyzer, produced jointly by OI Analytical (College Station, Texas, USA) and Picarro (Sunnyvale, California, USA).

Precision for the  $\delta^{13}\text{C}$  is as high as 0.2‰ in seconds or minutes, depending on sample specifics. No drying or other purification is necessary before introducing CO<sub>2</sub> directly into the CRDS unit.

The companies says the instrument can be used to analyze origins of foods (for example, is this olive oil from Greece or from Argentina?) and adulteration of products such as vegetable oils, seeds, nuts, chocolate, and dairy products. Edible oils derived from C3 and C4 plants can be distinguished by their isotopic carbon signature in this analytical system (see Fig. 2). (C3 plants, which include probably 95% of the world's plants, fix carbon through the Calvin cycle to form 3-phosphoglycerate as the first product. C4 plants form large amounts of four-carbon organic acids as the first products of CO<sub>2</sub> fixation and include corn, sorghum, and sugarcane.)

For further information, see [www.picarro.com](http://www.picarro.com).

## GENERAL

Gerstel (Mülheim an der Ruhr, Germany, and Lincicum, Maryland, USA; [www.gerstel.de](http://www.gerstel.de)) presented several tools for the automated analysis of fats and oils. (i) The Caviezel method for determination of fat content is based on the US Food and Drug Administration definition of total fat as being total lipid fatty acids, including fatty acids from triglycerides, phospholipids, sterols, and free fatty acids. Gerstel presented an analytical system for routine fat analysis based on a Büchi (New Castle, Delaware, USA) B 815 extraction unit, an Agilent 7890 gas chromatograph with a split/splitless inlet and a flame ionization detector, and a Gerstel Multipurpose Sampler (MPS). Following addition of an internal standard to the sample, fat is automatically extracted and then subjected to alkaline digestion. The resultant salts are converted to free acids for determination. The automated sample preparation and sample introduction were the features emphasized.

(ii) Fatty acid methyl ester (FAME) determinations can be carried out with automated sample preparation (hydrolysis of

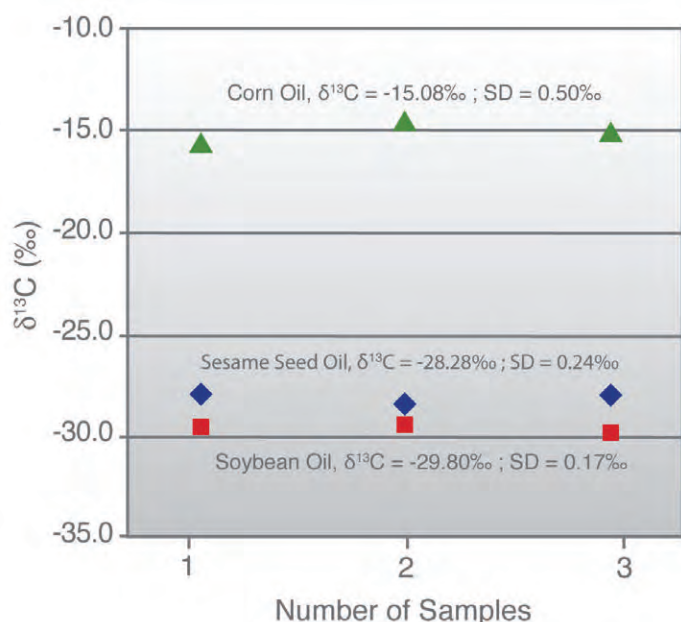


triglycerides followed by derivatization to FAME) on the Gerstel PrepStation at the same time that gas chromatographic or liquid chromatographic analysis of the preceding sample is carried out. Samples are prepared on a just-in-time basis so that the analysis system never waits idly for the next sample, thus reducing the risk of decomposition of labile analytes or labile derivatives.

(iii) Gerstel also was marketing a new method for monitoring rancidity in oily matrices, based on the determination of aldehydes and ketones (resulting from the oxidation of long-chain polyunsaturated fatty acids) using an automated dynamic headspace technique coupled with gas chromatography/mass spectrometry. The method has been shown to work well with olive oils, rapeseed oils, and fish oils. Limits of determination for marker compounds are in the range of 0.05–5 ng/g.

ThermoFisher Scientific (Waltham, Massachusetts, USA; [www.thermo.com/arena](http://www.thermo.com/arena)) introduced a rapid automated method to analyze asparagine, which reacts with reducing sugars, such as glucose at  $>160^{\circ}\text{C}$ , to form acrylamide, a suspected carcinogen. Formation of acrylamide is a concern in the processing of fried, baked, or roasted processed foods. Asparagine can be determined in both raw and processed foods photometrically with the company's Arena analyzer. Disposable multicell cuvette technology virtually eliminates carryover. Several analytes from a single sample can be measured simultaneously.

Magellan Biosciences (Chelmsford, Massachusetts, USA; [www.esainc.com](http://www.esainc.com)) introduced an ultra-high-performance version of its Corona *ultra* Charged Aerosol Detector (CAD). The company says this detection technology allows one to see any nonvolatile analyte, even those without a chromophore. This detector provides reduced peak dispersion and a 100-Hz acquisition rate. Run times are five times faster than with conventional systems, and about one-fifth the amount of solvent is needed compared with a



**FIG. 2.** Edible oils derived from C3 and C4 plants can be distinguished by their isotopic carbon signature, with excellent precision and accuracy for  $\delta^{13}\text{C}$  measurements from solids and liquids, using the combustion process found in the *i*TOC-CRDS system. We thank Picarro, Inc. ([www.picarro.com](http://www.picarro.com)) for the use of these data from the *i*TOC-CRDS analyzer.

## NETWORKING AT PITTCON

Thirty-four formal Conferee Networking Sessions were on the Pittcon program, on topics ranging from analytical techniques, specific analytical systems, statistical issues, and laboratory information management systems to nontraditional employment for scientists and engineers, and energy efficiency and conservation.

Michael Cheng, of Chevron Energy and Technology Co., facilitated the “Bio-Fuels: Application, Transportation, Storage, and Production” session. About 25 people participated, representing companies such as ADM, Bayer Technology, Honeywell, Nalco, ExxonMobil, W.R. Grace, and Codexis, as well as academia and analytical laboratories. Despite the expansive “Bio-Fuels” title, most of the discussion focused on biodiesel.

One participant commented, “Biodiesel is easy to make, but it’s not that great a product.” That is, the chemistry to make fatty acid methyl esters is simple, requires nearly modular hardware, and uses readily available chemicals. Doing things the easy way is . . . well . . . easy, but it’s not always the best way. Many attendees described problems with precipitation of sludge-forming materials in biodiesel blends. Steryl glucosides were identified in 2007 as the culprits, but other polar compounds including monoglycerides, diglycerides, free fatty acids, and glycerin not only gum up fuel tanks but also adversely affect analytical systems that are based on gas chromatography and atomic emission. One attendee suggesting derivatizing samples before these analyses to reduce instrument fouling.

One networker described experiences that seemed to indicate that more polar compounds become immiscible with time and precipitate out but that the addition of antioxidants is an important way to prevent formation of this sludge. Another comment was that sludge formation was more prevalent in B5 (5% biodiesel + 95% petrodiesel) to B20 blends than in B100.

Several attendees brought up the need for reliable standards for use in biodiesel analyses. One offered the opinion that the only way to get an accurate determination of biodiesel content in a blended fuel is to use methods based on radiocarbon content. The discussion also considered whether a standard such as that sold by Supelco should be used, which is a standard rapeseed methyl ester. The ADM representative suggested, though, that a mixture containing the expected impurities would be better than a highly purified standard.

The meeting facilitator urged that the discussion be continued at the next Pittcon, to be held in Orlando, Florida, USA, in 2010.

conventional system. The company says the detector is suitable for analytical research and development through manufacturing quality control. Company representatives made poster presentations at Pittcon on the determination of free and acylated glycerols in biodiesel by HPLC-CAD and the analysis of lipids by reversed-phase HPLC (high-performance liquid chromatography) using the Corona CAD.

Reflecting what is happening throughout the world, a number of companies touted the environmental soundness and the “greenness” of their products. Erlab Group (Rowley, Massachusetts, USA; [www.erlab.com](http://www.erlab.com)) exhibited ductless filtering fume hood systems for chemical laboratories. Their Neutrodine® carbon filtration technology is able to handle acids, solvents, and bases with the same filter, making it able to compete with traditional fume hoods. Airflow within the adsorption media is 25% higher than with traditional carbon filtration, ensuring a face velocity of 100 fpm (feet per minute). Filters are modular, and once a filter has reached capacity it is removed, incinerated, and replaced with a new filter. AirClean Systems (Raleigh, North Carolina, USA; [www.aircleansystems.com](http://www.aircleansystems.com)) presented competing but similar products. Both Erlab and AirClean pointed out that a ductless system removes the need for ducting; since cleaned air is not discharged outside the building to the atmosphere, there are further savings because heated air is not discharged in winter nor cooled air in summer.

## BIOFUELS

Many companies are marketing analytical tools for determining the composition of and contaminants in biodiesel. Phenomenex (Torrance, California, USA; [www.phenomenex.com](http://www.phenomenex.com)) presented a method for the reliable analysis of free and total glycerin in biodiesel using their high-temperature, fused-silica gas chromatographic columns, Zebron ZB-5HT Inferno, which were specifically designed for analyses up to 430°C. The company says these columns have a much longer lifetime and are more rugged than standard fused-silica columns.

Metrohm USA (Riverview, Florida, USA; [www.metrohmusa.com](http://www.metrohmusa.com)) promoted a thermometric titration procedure, using a catalytically enhanced indication reaction (based on paraformaldehyde), to determine low-level total acid number in biodiesel and low-level free fatty acid content in edible fats and oils. The procedure is designed to avoid the drawbacks of the current colorimetric and potentiometric titrations for these parameters. End points of the titration are indicated by the reduction in solution temperature. The company says titrations take 10–60 seconds to complete, are reliable (the probe can be stored dry and never needs regenerating), and work with highly colored and turbid samples.

## MYCOTOXINS

Mycotoxins are economically important because they are produced by fungi found on foods such as grains, nuts, spices, and dairy products. Governmental limits are placed on the content in foods of mycotoxins such as aflatoxins (*Aspergillus flavus* and *A. parasiticus*), ochratoxins (*Aspergillus* spp., *Penicillium* spp.), zearalenone (*Fusarium* spp.), trichothecenes (*Fusarium*, *Trichothecium*, etc.), and fumonisins (*Fusarium* spp.) because of their toxic and/or carcinogenic properties.

Incorporating the LCTech (Dorfen, Germany) GPC ULTRA gel permeation chromatography instrument, Pickering Laboratories (Mountain View, California, USA; [www.pickeringlabs.com](http://www.pickeringlabs.com))

announced the development of a low-cost comprehensive mycotoxin screening method that, it said, could detect 31 mycotoxins in an edible oil sample in a single analysis. The GPC instrument separates low-weight mycotoxins from high molecular weight food constituents prior to high-performance liquid chromatographic separation and mass spectrometric detection. Recoveries for fumonisins, trichothecenes, aflatoxins, and ochratoxin A ranged from 74 to 104%.

Waters Corp. (Milford, Massachusetts, USA; [www.waters.com](http://www.waters.com)) was promoting a method for analyzing aflatoxins that uses Vicam (Watertown, Massachusetts; [www.vicam.com](http://www.vicam.com)) AflaTest cleanup columns and a single fluorescence detector, the Waters ACQUITY UPLC Fluorescence Detector. According to Waters' literature, there is no need to purchase a post-column derivatization system to be used downstream from the cleanup column. Use of the Acquity UPLC (ultra-performance liquid chromatography) fluorescence detector in place of high-performance liquid chromatography decreases analysis run time from 12.0 to 4.5 minutes. Elimination of derivatization and post-column flow lessens band broadening and provides sharper peaks. The methodology can also be used to quantify zearalenone and ochratoxin A.

## OF INTEREST

Hanna Instruments (Woonsocket, Rhode Island, USA; [www.hannainst.com](http://www.hannainst.com)) displayed a mini-titrator and pH meter, model HI 84437, designed specifically for the determination of titratable acidity in mayonnaise. The company says its clear and intuitive user interface permits quick operator set-up. Determining titration end points by pH electrode instead of color indicator improves precision by eliminating subjective readings.

INEOS Technologies (Naperville, Illinois, USA; [www.ineostechnologies.com](http://www.ineostechnologies.com)), which provides expertise in problem solving and testing capabilities in chromatography, elemental analysis, particle characterization, powder crystallography, and surface science, had on exhibit at its booth a poster entitled “Semiquantitative Analysis of Chocolate Sandwich Cookies.” The information presented on the poster originated with James Kaduk, who said the data represented a “Friday afternoon-type of project,” stimulated by musings over lunch as to why Oreo® sandwich cookies (a cream filling sandwiched between two chocolate cookies; Kraft Foods, Northfield, Illinois, USA) “taste so much better than” Famous Amos® creme-filled chocolate flavored sandwich cookies (Kellogg Company, Battle Creek, Michigan, USA). Kaduk applied his skills in X-ray powder diffraction (XRPD) to investigate the question. He found Oreo cookies contain much less free sucrose than Famous Amos. The fillings in each contain about two-thirds sucrose and one-third fat (determined by extracting the fillings with hexane). The fats in the fillings, however, differ. Low-angle peaks in the Oreo filling corresponded to stearates ( $C_{18}$ ), whereas those in the Famous Amos were from palmitates ( $C_{16}$ ). Kaduk said, “The fat in the Famous Amos filling is much softer than that in the Oreo, consistent with the shorter average chain length. The packing of the chains differs in the recrystallized fats . . . and such phase transitions may affect the mouthfeel of the fat.” The author also speculated on the kinds of information on *trans*-fats in food that could be obtained through XRPD.

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Marguerite Torrey is AOCs Technical Projects Editor. Contact her at [mtorrey@aocs.org](mailto:mtorrey@aocs.org).



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